THE UNITED STATES NAVY'S COMPETITIVE COMPUTER SELECTION SYSTEM IN RELATION TO ALTERNATIVE SYSTEMS

by

Fred Stanton Garner

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Bachelor of Science
University of Florida, 1958

A thesis submitted to the
School of Government and Business Administration
of
The George Washington University
in partial fulfillment of the requirements for the
Degree of Master of Business Administration

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JUNE 1970

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CHAPTER I

INTRODUCTION

Statement of Purpose

It is the purpose of this paper to define the competitive computer selection system used by the United States Navy. Other selection systems are described, and the Navy's system is evaluated in relation to these other systems.

Organization of Study

In keeping with its expressed purpose, this thesis is divided into several chapters, each chapter provides the reader with a logical element from the total package.

The competitive computer selection process used by the Department of the Navy is highly regulated and owes its origin to the fact that the Navy is a governmental agency with a central office responsible for the selection process. In Chapter II, the various controls exerted by Congress, the President, the Department of Defense, and the Secretary of the Navy are examined. The responsible central office is a very significant factor shaping the selection system. Accordingly, the

mission and organizational relationships of this office are defined.

Chapter III examines the details of the selection procedures. The total cycle of acquiring a computer system involves two distinct and separate phases. First, the user conducts a system study to define the management data system and prove its soundness. The second part concerns the procurement actions necessary to bring a computer system on board. This paper will address only the latter part of the cycle and thus assumes that a good system study has been conducted and the prospective user therefore knows his true systems requirements. Chapter III is therefore directed toward the five major activities that involve the central selection office. The five activities are: Specification Review, Preparation of the Request for Proposal and Selection Plan, Vendor Liaison and Validation of Proposals, Evaluation of Proposal, and Contract Negotiation and Award.

Chapter IV discusses the results of a survey conducted by Dr. Norman Schneidewind. This survey purports to show four different catergories of users, and what practices are used, to select computer systems. In addition, the validation techniques of computer simulation and hand timing are discussed. The latter part of this chapter is directed toward two alternative evaluation systems--the Cost-Effectiveness and the Weighted Scoring methods.

Chapter V evaluates each of the five major activities in the Navy selection process in relation to the methods described in Chapter IV. Chapter VI summarizes the findings of the study.

Statement of Research Question

This thesis provides answers to the following questions:

- What is the relationship of the Navy's system to alternative systems that might be used?
- What are the significant features of the competitive computer selection used by the United States Navy?
- What alternative methods could be used?
- What are the strong points in the Navy's system?
- What are the controls imposed by higher authority?
- Who in the Navy is responsible for the selection process?

CHAPTER II

THE GOVERNMENT ENVIRONMENT

The system the United States Navy uses to competitively select computers is a result of the interaction of many and diverse influences. There are strong pressures exerted on the Navy by such external forces as the United States Congress, the President of the United States, the Bureau of the Budget, the Department of Defense and many others. In addition, there are active forces within the Navy itself. The most significant action element in the Navy is the Automatic Data Processing Equipment Selection Office. The purpose of this chapter will be to define these influences. The effect of these forces will be examined in Chapter III.

Congressional Influence

The most significant influence exerted by the Congress is Public Law 89-306 enacted on October 30, 1965. This law is known as the Brooks Bill because the legislation is a product of the Government Activities Subcommittee of the House Committee on Government Operations, Congressman Jack Brooks is chairman

of this subcommittee.[1] The need for this legislation was defined by the subcommittee in its report on H. R. 4845:

> Since 1958, up to the time of the hearings on H. R. 4845, the GAO has issued approximately 100 audit reports to agencies, congressional committees, and to Congress revealing serious shortcomings in the manner in which specific agencies acquired and/or utilized ADP equipment. The major deficiencies cited in these reports have been:
> (a) Inadequate feasibility studies;
> (b) Uneconomical and ineffective equipment utilization;
> (c) Overpayments resulting from inadequate management practices; and
> (d) Uneconomical procurement of equipment.[2]

Based on this need, the Brooks Bill purports to satisfy three vital management needs: (1) more adequate management information, (2) optimum utilization of ADP (Automatic Data Processing) equipment through sharing, and (3) multiple use and economic acquisition. The subcommittee indicated that an economical acquisition program involved three principal factors:

> (a) Improving the Government's bargaining position through volume acquisition;
> (b) Basing lease versus purchase evaluations, whenever possible, on the long-term value of the equipment to Government as a whole; and
> (c) Selecting that equipment for purchase which, on a Government-wide basis Offers the largest purchase advantage.[3]

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[1]U.S., Congress, House, Committee on Government Operations, Automatic Data Processing Equipment, Hearings, before a subcommittee of the Committee on Government Operations, House of Representatives, on H.R. 4845, 89th Cong., 1st sess., 1965, p. II.

[2]H.R. Rep. No. 802, 89th Cong., 1st sess., 1965, p. 17.

[3]Ibid., p. 23.

To satisfy the needs of management as cited above, Public Law 89-306 increased the authority and responsibility of three federal agencies: the General Services Administration, the Bureau of the Budget, and the National Bureau of Standards in the Department of Commerce.

The Bureau of the Budget is charged with the fiscal and policy control of ADP management of the government. The bill provides that the actions of any agency taken under the authority of the law are subject to the review and approval of the Bureau of the Budget.

The Administrator of the General Services Administration (GSA) is charged with the primary responsibility for coordinating the government's ADP management, subject to the policy and fiscal control of the Bureau of the Budget. The law specifically directs the administrator to "coordinate and provide for the economic and efficient purchase, lease, and maintenance of automatic data processing equipment by Federal agencies."[4] The bill however does limit this authority. Each agency was given the latitude to continue determining what their ADP requirements were.

The National Bureau of Standards is responsible for the technical aspects of this coordinated management program. The Bureau is responsible for conducting research and development programs based on the needs of the government. The

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[4] Federal Property and Administrative Services Act of 1949 (63 Stat. 377) as amended, Sec. 111.(a).

drafters of the bill intended for the Bureau of Standards to direct its attention toward the problem of lack of equipment compatability. The intent of the law however was not to authorize the Bureau to launch a broad research and development program. Rather, the intent was aimed at supplementing the government research effort in coordination with other federal agencies and monitoring developments in the industry affecting areas covered by the law. A copy of Public Law 89-306 is shown in Appendix A.

Presidential Influence

President Lyndon B. Johnson on June 28, 1966, sent a memo to the heads of all federal agencies. The purpose of the memo was to stimulate action to improve the management of the ADP resources in the government. The President referred to the recognition that the Congress had given to this problem by enacting the Brooks Bill. President Johnson pointed to the fact that the federal government was using 2,600 computers, employing 71,000 people in the field, and spending over $2 billion annually to acquire and operate ADP equipment. The President said: "I want the head of every Federal agency to explore and apply all possible means to use the electronic computer to do a better job . . . manage computer activity at the lowest possible cost."[5] The President pointed to four specific areas that were to be

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[5]Lyndon B. Johnson, Memorandum to Heads of All Federal Agencies, 28 June 1966.

given priority attention: better methods of procuring ADP systems; achieving better utilization of existing capabilities through sharing and joint use arrangements; re-utilizing excess equipment when possible; and achieving greater compatability.

The President indicated to the Heads of the Agencies that he expected them to cooperate fully with the Bureau of the Budget, the General Services Administration, and the Department of Commerce in accomplishing these actions. (See Appendix B for a copy of the President's memorandum.)

Secretary of Defense Influence

Secretary McNamara acted upon the President's memorandum with a statement of policy to the top management of the Department of Defense (DOD).[6] The Secretary indicated his desire to attain the objectives set down by the President but further a desire to set an example to the rest of the government agencies. The memorandum pointed to the fact that DOD operated 2,000 of the 2,600 computers cited in the President's memo and employed 51,000 of the 71,000 federal employees engaged in the ADP effort. It was therefore the view of the Secretary of Defense that DOD had

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[6]Robert S. McNamara, Memorandum to The Secretaries of the Military Departments, The Chairman of the Joint Chiefs of Staff, The Director of Defense Research and Engineering, The Assistant Secretaries of Defense, The Director of Defense Agencies, 29 July 1966.

to bear a large share of responsibility for improved management of the governments ADP resources.

The Secretary's memorandum defined the areas that required management attention. There are several items of specific interests in this paper:

> (a) We must, prior to computer selection, develop and issue systems specifications which adequately describe the systems to be performed and which will result in selection of computers which can satisfy the requirements of that specification. We should not be forced to acquire additional units at later dates or replace the computers prematurely because of selections based on inadequate system specifications or on less than responsive vendor proposals. Military Departments and DOD agencies should centrally prescribe and control the development of systems specifications for computer acquisition purposes.
>
> (b) We must make competitive computer evaluation and selection a professional endeavor and organize and staff for it accordingly. Staffs performing this function for the senior automatic data processing policy officials should be divorced from computer-using organizations. Steps should be taken to assure that these staffs are the sole point of contact with the computer industry on all matters pertaining to computer selection for their respective agencies.
>
> (c) . . . Further, computers will not be selected until the performance of the complete hardware/software package required in the systems specification and request for proposal has been clearly demonstrated by either a full-scale or bench mark test. (Emphasis supplied.)[7]

Secretary of the Navy Action

The Secretary of the Navy initiated a study effort within the Department of the Navy to define the actions that should be taken to satisfy the policy statements of President Johnson and Secretary McNamara.

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[7] Ibid.

An instruction signed by Secretary of the Navy Paul H. Nitze on June 30, 1967 established the Automatic Data Processing Equipment Selection Office (ADPESO). The mission assigned to this office is:

> a. To evaluate and select for approval by the Special Assistant to the Secretary of the Navy (SASN), automatic data processing equipment to be acquired by the Department of the Navy, except as defined in paragraph 4 below.
>
> b. To act as the Department of the Navy contracting office for the procurement of ADPE.

The exception mentioned above relates to equipments integrated with weapons systems, punch card equipment, and other special situations exempted by SASN.

The functions assigned ADPESO are:

> (a) Serve as the principal point of contact with the industry on matters concerning validation, evaluation, selection, and procurement of ADPE for the Department of the Navy.
>
> (b) Develop and administer for the Department of the Navy plans, policies, procedures and methods governing ADPE specification preparation, proposal solicitation, proposal evaluation and selection.
>
> (c) To solicit sources, negotiate and award contracts, place delivery orders against Federal Supply Schedules and administer contracts and orders for such ADPE acquisitions.[8]

The Director of the Automatic Data Processing Equipment Selection Office, reports to the Special Assistant to the Secretary of the Navy. Thus he is very high

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[8]U.S., Department of the Navy, "Automatic Data Processing Equipment Selection Office; establishment of," Secretary of the Navy Instruction 5430.81, Department of the Navy, Washington, D.C., 20390, June 30, 1967.

in the Navy department hierarchy and is separated from computer-using organizations. (See Appendix D for a diagram of this organizational alignment.)

ADPESO Action

Upon completion of the first milestone of organizing and staffing, management turned and directed it attention toward the mission assigned to ADPESO. In order for this to be done, the methods of operation had to be defined and approved. This effort required ADPESO personnel to gather the various directives and regulations that apply to ADP management in the government. There is a large number of directives toward this end. (See Appendix E.) For the purposes of this paper however, only the most significant ones will be discussed.

Bureau of the Budget Circular No. A-54:
Policies on Selection and Acquisition of Automatic Data Processing Equipment

The purpose of this directive is to prescribe the government's policy concerning ADP equipment selection and provide guidance relative to the method of acquisition-lease, purchase or a lease with an option to purchase method.

The government's policy concerning selection specifies: that all selections will be made based on a set of systems specifications; that selection procedures will assure equal opportunity for all manufacturers to participate; that the two prime factors to be considered in the selection process are (1) the equipment's ability to

fulfill the systems specification, and (2) its overall costs including those applicable to acquisition, preparation for use and operation.

The agency in question is obliged to select that method of ADPE acquisition which offers the greatest advantage to the government. The purchase method is to be used when all the following conditions exist:

- There is a reasonable expectancy that the ADPE in question can be successfully and advantageously used;
- That after a comparative cost analysis has been conducted, it is established that a cost advantage can be obtained in six years or less and the cost of money[9] has to be used in conducting this cost analysis;
- The ADPE will be able to satisfy the requirements of the system beyond the point where the purchase method provides a cost advantage; and
- The feasibility and economics of performing equipment maintenance with in-house resources has been considered.

The lease-with-option-to-purchase method is to be used when it is necessary or advantageous to acquire the equipment, but it is preferable to defer temporarily the decision to purchase when circumstances do not fully satisfy the conditions which would indicate purchase.

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[9]The procedure used is defined by Bureau of the Budget Circular A-94. A sample problem from this circular is shown as Appendix J.

The lease method, without option to purchase, should be used when it is advantageous or necessary to acquire the equipment and when it has been determined that anyone of the prerequisite conditions of purchase cannot be attained.

Department of Defense Directive 4105.62:
Proposal Evaluation and Source Selection

The purpose of this directive is to establish the objectives, principles, and policy for the evaluation of proposals and the selection of contractual sources. The directive defines three very significant parties and their roles in the selection process.

First is the Source Selection Authority (SSA). He is an official designated to direct the source selection process and to make the source selection decision. The principal duties of this official are:

1. Designate the chairmen and the membership of the Source Selection Advisory Council.

2. Establish guidelines for the actions to be taken by the Source Selection Advisory Council and the Source Selection Evaluation Board.

3. Make the decision as to the source, after an in-depth review and consideration of all information and data available from the Source Selection Advisory Council and the Source Selection Evaluation Board.

Second is the Source Selection Advisory Council (SSAC). It is composed of a group of senior military and civilian personnel and is appointed by the SSA and acts as his staff and advisors in the source selection process. The principal duties of this group are:

1. Establish the evaluation criteria and assign weight factors to each item using the recommendations of the Selection Plan which was prepared by the System/Project office, in this case ADPESO.

2. Designate the chairman and members of the Source Selection Evaluation Board.

3. Review the findings of the Source Selection Evaluation Board.

Third is the Source Selection Evaluation Board (SSEB). This is a group of military and civilian personnel, from the various functional and technical areas. The duties of this group are:

1. Evaluate and score the proposals submitted by the bidders; and

2. Prepare a narrative justification for the evaluation results.

This directive thus establishes a three-level review process for the evaluation of system proposals.

Based on these various directives and the knowledge and expertise of the staff of ADPESO, the Navy's computer selection process was developed. While the many directives provided broad policy guidelines, detail methods or techniques were not specified.

The method of evaluating the proposals is based on a system called the "Cost-Value Technique" from a book by Edward O. Joslin, Computer Selection.[10] Mr. Joslin wrote this book while attending Boston College and working for EDP Equipment (Selection) Office of the U.S. Air Force. Currently he is Head of the Techniques Development and Analysis Division at ADPESO.

The next chapter will treat the details of the Navy's Competitive Computer Selection System.

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[10]Edward O. Joslin, Computer Selection, (Reading, Massachusetts: Addison Wesley Publishing Company, Inc., 1968), p. 20.

CHAPTER III

U.S. NAVY COMPETITIVE COMPUTER SELECTION SYSTEM

The Navy's competitive computer selection system starts when the system specifications for a particular data system are sent to the ADPESO for action. The actions taken by ADPESO can be arranged into five steps:

Specification Review,

Preparation of the Request for Proposal (RFP), and Selection Plan,

Vendor Liaison and Proposal Validation,

Proposal Evaluation, and

Negotiation and Contract Award.

Each of these areas will be discussed and explained.

Specification Review

The ADPESO actually performs three different reviews of each set of specifications. The purpose of the first is to determine if the user's requirement can be satisfactorily satisfied by sharing a computer system currently operative in some other area, or by reutilization of some system not in use or scheduled to become idle and owned by the government. The second review is conducted to

determine whether this requirement should be satisfied by a competitive or a sole source procurement action. While these two reviews are important they are not germane to the subject of this paper; accordingly attention will be devoted to the third review only.

The third review performed by ADPESO is concerned with the data contained in the system specifications.[1] Three parts of the user's requirements are analyzed. First, the justifications provided for conditions stated as mandatory are checked. Second, the review examines the rationale provided for the requirements described as desirable features. The last part of this review is concerned with the workload description.

Justification of Mandatory Requirements

A mandatory requirement is defined as, "those requirements which the supplier must satisfy to be considered."[2] The Navy's policy is that the mandatory requirements shall not be stated in a manner that will restrict the free competition among all of the qualified bidders. Further the requirements cannot be oriented toward any specific vendor's equipment, software, or services.

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[1]U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13, Department of the Navy, Washington, D.C. 20390, p. B-2. The format for the systems specifications is shown in Appendix F.

[2]Ibid., p. B-11.

The specifications must be reviewed to insure that the user has justified all mandatory requirements, and that the number of them is held to a minimum. In addition the reviewer must insure that the requirement does not restrict free competition in any way. The justification for any mandatory item has to be expressed in terms of " . . . why alternative approaches would not prove satisfactory. This justification should show that the cost of effectively satisfying the requirement in any alternate way would be prohibitive, or that the required effectiveness can only be satisfied in the way shown."[3] A special check is also made to ensure that mandatory supplier capabilities, i.e., system maintenance, training, and conversion, etc., are not confused with mandatory system requirements. An example of some mandatory requirements and the types of justification required is shown in Figure 1.

Following are examples of requirements that could, if properly justified, be mandatory.[4]

- Equipment Availability

If the equipment must be installed and operational by a specific calendar date to meet the requirement of the system(s), the user indicates the latest acceptable operational date. It should be noted that to specify a date is an exception to the normal practice.

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[3] Ibid., p. B-2.

[4] Ibid., p. B-11.

Mandatory Requirements	Justification
a. Supplier Support - The supplier must agree to:	
(1) Train or provide training for, system analyst, programmers, and operating personnel.	(1) The supplier must at least be responsible for the training to assure that the training is of the proper type. If this training does not provide the proper information the system cannot be properly utilized.
(2) The maintenance personnel provided must have a SECRET Security Clearance.	(2) This is necessary to meet local security requirements. See paragraph _____.
b. Workload Demonstration - The benchmarks must be successfully run in 5.00 hours or less.	Completion of the benchmarks is required to demonstrate the timing capability of the proposed system. Failure to complete the benchmarks in less than 5.00 hours would indicate that the supplier's equipment could not complete the activity's projected workload in the 600 hours a month available. Completion of the benchmarks will a also provide the validation of the existence of a suitable executive system and compiler.
c. COBOL Compiler - The COBOL Compiler proposed and demonstrated with this system must be a USASI Standard COBOL Compiler (X3.23-1968).	This is required for compliance with Department of Defense acceptance of the USASI Standard.

SOURCE: U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13, Department of the Navy, Washington, D.C. 20390, p. B-12.

Figure 1 — Mandatory Requirements and Their Justification

- Special Input/Output Requirements

If special or nonstandard equipment must interface with the required equipment, or if some special characteristics are required, such as special character sets for the printer, minimum print characters per line, etc., the requirement must be stated in such detail that the vendors will understand it.

- Operational Requirements

The user would define here any requirement that exists for a reserve for planned expansion, mobilization, and unavoidable workload peaking. Additionally, any requirement that all or certain portions of processing must be accomplished within a certain time frame are to be indicated. If the system is a real-time system the user can indicate the response time required. If the user has a peak load that must be completed during a specific time frame, the requirement must be stated in such sufficient detail that the suppliers can properly evaluate the situation.

- Communications

The user may have special communications requirements, such as remote stations, interface with communications network terminals or tributary terminal devices, etc. If this is the case then the requirements must be defined so the vendors can respond properly.

- Security Requirement

This is particularly applicable to Department of Defense activities. If the user's system does involve national security matters the rules applicable to the

supplier and the proposed installations must be stated. In addition the applicable regulation must be cited.

- Expansion Capability

The user should state the expansion capability required of the system for each year of the systems life. This is specified as a percentage increase over the first year, or by increased yearly extension factors.

There are other mandatory conditions which might be specified. Normally the user will state the amount of time, per month, that is acceptable for completion of the workload. This is determined based on the time required to complete the benchmark. The determination process will be reviewed later.

The experience to date indicates that most conditions claimed as mandatory are not usually sufficiently justified, so the requirement is classified as a desirable. It is also possible that as the threshold or limit changes, the condition can be treated as a mandatory requirement under one set of criteria and also as a desirable feature using a different criterion; for example, it might be a mandatory requirement that the supplier install the proposed equipment not later than a given date, and desirable for it to be installed earlier.[5]

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[5] E.O. Joslin, "Competitive Computer Selection Within the Department of the Navy," (unpublished paper presented to the Diebold Group, Inc., October, 1969. Mr. Joslin is Head, Techniques Development and Analysis Division of ADPESO).

Rationale For Desirable Features

A desirable feature is defined as "those features, characteristics, and services which the user desires, but which are not mandatory for a supplier to provide to be considered as meeting the overall requirement."[6]

For each desirable feature specified by the user, a statement of value has to be given as a justification. The value has to be stated in terms of dollars over the life of the system. However, the rationale required to define a desirable condition is less rigid than that required of a mandatory item. A review of statements of desirable features, will attempt to find two characteristics. First: is the item adequately described and second does the rationale show why the item is desirable. The only acceptable explanation of desirability is one expressed in dollar terms. In fact when possible the user is suppose to provide two value or worth figures. One figure defines the savings or cost avoidance that will be realized if the feature is provided. The second figure provides the cost of achieving this desirable in any possible alternative way. The lower of these two figures is the value assigned to that feature.

Following is a list of the type items which may be listed as desirable features.[7]

- Equipment Availability

The user can indicate the desirability of having the equipment installed as much as three months in advance of the required delivery date.

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[6]SecNavInst 10462.13, p. B-11.

[7]Ibid., p. B-14.

- Software

If the user desires any software packages to be provided by the vendor, each one is described. Some examples are: report generators, sort routines, scientific subroutines (such as general factor analyses, multi-discriminant analyses, etc.), and PERT cost and time.

- Supplier Support

The user can specify items of support desired of the supplier such as, training to be conducted on-site, some number of man-months of analyst support in conversion of programs to the new system, and on-site maintenance.

- Mathematical Computation

Special mathematical capability can be requested such as the ability to handle floating point computation.

- Utilization Log

The user can request that the equipment, in conjunction with software, provide a daily utilization report by job number.

Figure 2 shows some examples of desirable features and the corresponding value statements.

Statement of Workload

During the review of the mandatory and desirable features, the reviewer must also concern himself with the workload definition. This is so

Desirable Features	Value Statement
1. Flow charting program for COBOL	It is estimated that a potential cost avoidance of $60,000 would accrue to the government with the use of a Flow chart preparation program. This is based upon programmers devoting 5 per cent of their time to the task of flow charting. A staff of thirty earning an average of $9,000 annually for four years is $1,080,000. Five per cent of this figure is $54,000. However, it is estimated that this would cost 528 hours of computer time over four years. At $37.50 per hour (non-peak time value), this is $19,800 total cost. Therefore, a net savings of $34,200 will result. An alternate source of supply for such a program indicates a cost of $8,000. This cost was obtained from quotes received from private industry suppliers. Therefore, this alternate source cost of $8,000 is taken to be the value of this program.
2. Expansion capability of up to fifty per cent over the stated life workload	A system which would require the full five hours to meet the mandatory requirement for completing the benchmarks would have the required life of five years and is expected to cost $1,000,000. However, the stated system life is based on expansion of the workload which has already been assigned to this organization. In addition to the capability to handle the known workload, it would be desirable to be able to handle two additional projects which have a fifty per cent chance of being assigned to this organization. The first project (project XYZ) would require an additional capability of approximately thirty per cent of that required for the stated workload. The second project (project ABC) would require an additional time capability of twenty per cent and would also require the availability of a remote tem terminal. Our ability to handle project XYZ could save an ultimate expenditure of $300,000 over a three year period in contracted computer time. Likewise, the ability to handle project ABC could result in savings of

Figure 2 — Statements of Value

Desirable Features	Value Statement
	$200,000. However, because there is only a fifty per cent chance of these projects being assigned to this organization only half of the possible $500,000 saving, or $250,000 is being stated as the value of this expansion capability.
3. Supplier provided on-site training of sixty programmers, thirty analysts, and ten operators	If this training is not provided by the supplier, a cost of approximately $20,000 would be incurred in hiring a consultant to supply this training in accordance with the supplier's direction. If this training is not accomplished on-site, an additional cost of approximately 200 man-weeks (assuming two week courses) of per diem or $19,200 plus travel cost could be incurred.
4. On-site maintenance	If on-call maintenance is all that is offered, this would mean one or two hours of additional lost time per call, and with the expected five calls a month, this could mean ten hours of lost time per month or 600 hours over the life of the system. This lost time is estimated to be worth $12,000.
SOURCE: U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13, Department of the Navy, Washington, D.C. 2-390, p. B-15.	

Figure 2 — Statements of Value - Continued

because many of the mandatory and desirable features relate to the vendor's capability to complete the workload satisfactorily.

The review of the using activities workload is concerned with insuring that the expected workload is described in terms of the expected levels of workload and in terms of the representative programs or tasks plus the related extension factors

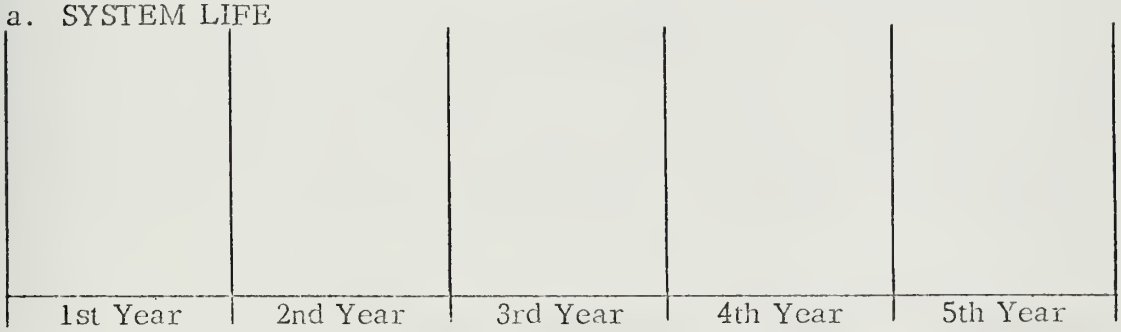
applicable to the workload levels. Each of these factors, workload levels and representative programs, will be discussed individually.

Expected Workload Levels

The workload to be processed on any system can be considered as consisting of a series of various levels. As the system ages, the workload usually increases from one level to the next. However, because of the problems associated with projecting future workload growth, it would be unreasonable to expect that the user could be 100 per cent accurate in projecting the workload for the life of the system. Accordingly the user is directed to use probabilities to predict future workloads in the following manner:[8]

1. System Life - the user prepares a chart that shows the number of years the system will be in existence.

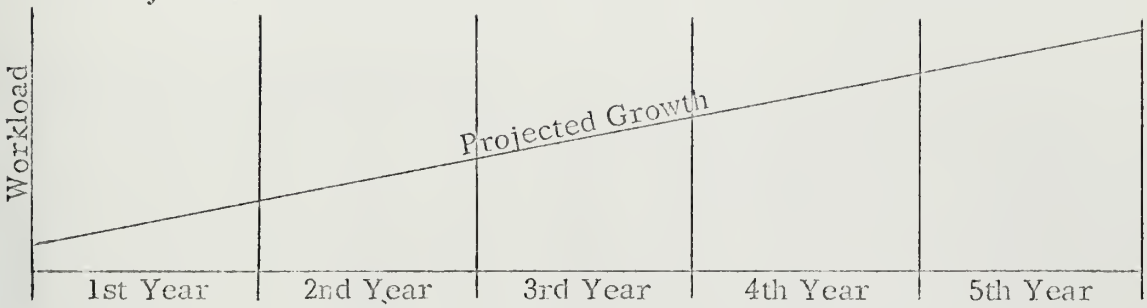
a. SYSTEM LIFE



[8]Joslin, "Competitive Computer Selection," p. 13.

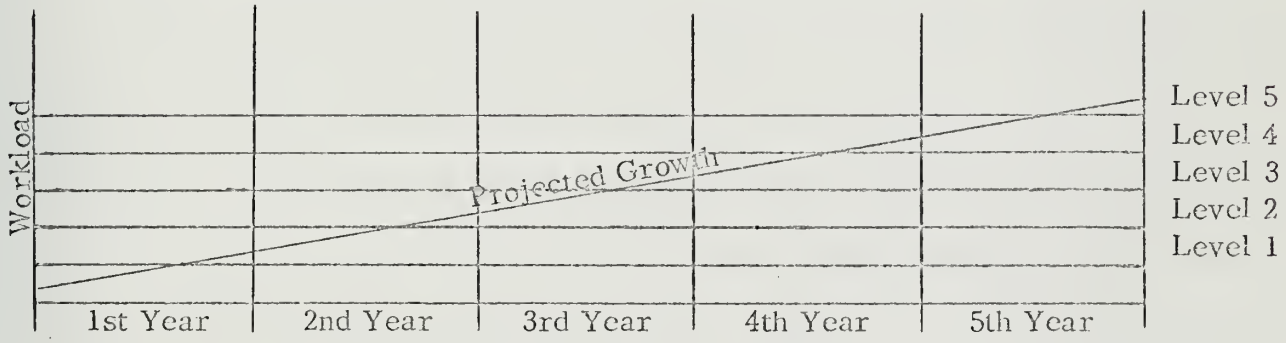
2. Projected Growth - an approximation of the predicted growth in workload is superimposed on the basic "System Life" chart a.. The vertical axis represents workload in hours-per-month.

b. PROJECTED GROWTH



3. Workload Levels - the user constructs a workload level line by drawing a horizontal line through the midpoint of the projected growth line for each year.

c. WORKLOAD LEVELS



4. Level of Probability - for each year a probability factor is assigned to each workload level. The total probability for any one year is considered to be 100. In illustration d. the user has indicated that during the first year there is a 90 per cent chance that the workload will be at Level 1 and a 10 per cent chance it will be at

Level 2. Note in the illustration below that the number of workload levels was increased to seven. This was done to take care of a situation where there is a probability the workload will exceed the projected growth line in the fourth and fifth years.

d. LEVEL OF PROBABILITY

	1st Year	2nd Year	3rd Year	4th Year	5th Year	
	0	0	0	0	5	Level 7
	0	0	0	5	15	Level 6
	0	0	0	15	70	Level 5
	0	0	10	75	10	Level 4
	0	10	80	5	0	Level 3
	10	85	5	0	0	Level 2
	90	5	0	0	0	Level 1

Workload

Representative Programs

This is a very important part of the systems specifications. The representative programs are the vehicles that will be used to time the proposed computer systems. The essence of this approach is that a program called a "representative program" is selected to represent a specific portion of the total monthly workload. Thus, a group of representative programs represents the total monthly workload. These programs which become benchmarks, in conjunction with the extension factors, provide the tools to project the monthly running time for the systems proposed by each vendor.

In view of the importance of this factor the review conducted by ADPESO is particularly critical. The reviewer looks to insure that certain facets are properly addressed. For example, the benchmarks should be written in a standard higher

level programming language such as: USASI Fortran or USASI COBOL. The vendor should be able to run all programs during a single half-day benchmark demonstration.

The reviewer has to insure that the user has selected a truly representative program. This means that the benchmark problem must be representative of the following:[9]

1. Types of processing: logic, computation, housekeeping, etc.
2. Time requirements: compile, execute, tapes, card units, printers, etc.
3. Equipment Requirements: core, input/output channels, tapes, card units, printers, etc.
4. Order of problems (priority).

The review also has to establish that the user has properly equated each benchmark to a portion of the workload. This is particularly important for as previously mentioned, the performance demonstrated on the benchmark is extrapolated to define the total monthly workload.

The extension factor, a number derived for each representative program, is the next vital element to be verified. The running time of each benchmark is multiplied by this factor to arrive at the monthly running time for the class of tasks represented by that program. An extension is required for both sequential systems and for multi-processing systems. The user should have prepared a table similar to Figure 3. For each representative program there should be entries in the table showing the total monthly time consumed by each program, the running time of the representative task or program and the division of the total by the representative

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[9]Edward O. Joslin, Computer Selection (Reading, Massachusetts: Addison-Wesley Publishing Company, 1968), p. 77.

Workload		Time (Hours and Hundredths)		Extension Factors
Task Set	Functions	Monthly Task	Representative Task (Single Run)	
Sort B-1A	Total thruput	145.00	0.45	322
	Mag. tape	125.00	0.25	500
	Card Reader	115.00	0.03	3833
Edit E-4a	Total thruput	120.00	0.75	160
	Mag. tape	80.00	0.60	133
	Card Reader	20.00	0.50	40
	Printer	100.00	0.25	400
Update D-5a	Total thruput	100.00	0.16	625
	Mag. tape	70.00	0.10	700
	Card Reader	25.00	0.05	500
	Printer	50.00	0.10	500
Matrix Inversion K-6a	Total thruput	90.00	0.45	200
	Card Reader	3.50	0.02	175
	Mag. drum	24.00	0.15	160
	Printer	1.50	0.01	150
FORTRAN Compile H-3a	Total thruput	85.00	0.17	500
	Mag. tape	78.00	0.15	520
	Card Reader	6.00	0.02	300
	Printer	4.00	0.01	400
COBOL Compile G-2	Total thruput	40.00	0.12	333
	Mag. tape	38.00	0.11	345
	Card Reader	4.00	0.04	100
	Printer	3.00	0.04	75
Tape to Print F-4	Total thruput	300.00	1.00	300
	Mag. tape	300.00	1.00	300
	Printer	300.00	1.00	300
	TOTAL MONTHLY TIME 880.00			

SOURCE: U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13,—Department of the Navy, Washington, D.C. 20390, p. B-4.

Figure 3 — Representative Programs

program and this becomes the extension factor. Expressed another way, the extension factor is:

$$X = \frac{Y}{Z}$$

Y = Total monthly time to perform total task set on present equipment system

Z = Throughput time to run the representative program
(1) on present equipment (subscript a)
(2) on proposed equipment (subscript b)

X = Extension factor for representative task.

Therefore:

$X(Z_b)$ = Suppliers time for total task[10]

The user also has to show how these individual representative programs can be grouped into a mix of programs that has its own extension factor, which is representative of the total workload. The purpose of this mix of representative programs and related factors is for use in demonstrating the multiprogramming or multiprocessing capability. The mix of programs as modified by quantity and provisions, should be such that when the times for the present representative programs are multiplied by the extension factors the result will be the total time which should closely approximate the present total time. Figure 4 demonstrates this situation.

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[10]SecNavInst 10462.13, p. B-5.

Program	Quantity	Provisions
B-1a	2	Normal
E-4a	1	Input from tape
D-5a	4	Twice Normal Twice no output
K-6a	1	Normal
H-3a	3	Normal
G-2	2	Normal
F-4	2	Normal
Extension Factor for Mix: 160*		

*This extension factor for the mix is derived by examining the information contained in Figure 4 and obtaining the lowest practical extension factor to reduce the number of problems to be run in the mix while retaining the required representative nature of the mix of problems, which in this case is 160. This extension factor is then divided into each of the sequential extension factors to obtain the quantity column. The provisions column is then used to make the input/output total time when extended by the mix extension factor equal to the total projected input/output time. This mix of tasks (15) can then be used as a proper demonstration of a supplier's multi-programming or multi-processing.

SOURCE: U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13, Department of the Navy, Washington, D.C. 2-390, p. B-6.

Figure 4 — Extension Factors

The extension factors initially calculated are for the first year of the systems life. Accordingly, the user must also provide extension factors applicable to the second, third, fourth, and fifth year of the systems life.

The final check the reviewer makes is to insure that the user has provided a

description of each of the benchmark programs and copies of the program detail listing.

If the user has properly justified the mandatory requirements, evaluated the desirable features, and described the workload, the specifications are ready for the next action. The specifications are forwarded to the Source ~~Solution~~ Selection Evaluation Board for the preparation of the Request for Proposal which will be forwarded to the vendors, and the Selection Plan which is held in-house for official use only.

Preparation of the RFP and Selection Plan

Provided the specifications were properly prepared, the preparation of the RFP and Selection Plan is a relatively simple task.[11]

The RFP consists of a cover letter, the systems specifications, less the justification of mandatory requirements and the rationale for desirable features, and a set of instructions addressed to the vendors. These instructions tell the vendors how to prepare their proposals; lists some mandatory administrative details and defines how the cost for the proposals should be computed and shown. Before this can be mailed to the vendors through, the Selection Plan has to be developed.

The purpose of the Selection Plan is to establish a detail set of instructions that will govern how the vendor proposals will be evaluated. It should be noted at this point that in the Navy's system it is the desirable features requested by the user that

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[11]Joslin, "Competitive Computer Selection, p. 22.

are evaluated. The mandatory requirements are not evaluated they are validated.[12]

The desirable features and the values assigned to each are carefully analyzed. Based on this information a value templet is constructed for each feature. These templets show how the total value for each item will be apportioned as various quantities or qualities of the item are proposed. In actual practice these value statements are prepared when the RFP is being prepared. The purpose of this is to insure agreement between the RFP and the Selection Plan.

Another examination of the mandatory requirements is also conducted at this time. The reason for this second review of these requirements is to determine if any items initially classified as mandatory can be re-classified as desirable. Experience has shown that some mandatory items are really desirable in the sense that dollars can sometimes make up for a slight deficiency in a mandatory requirement.[13]

There are four parts in a value statement:

1. A Statement of the Desirable Feature - provides the exact and entire statement of the desirable feature as it appears in the RFP.

2. Rationale - This section shows the derivation of the worth or value of the feature. The worth is defined by considering the following:

   a. The cost of doing without the capability;

   b. The cost of satisfying the requirement by using in-house resources;

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[12]SecNavInst 10462.13, p. B-11.

[13]Joslin, "Competitive Computer Selection," p. 23.

c. The cost of having the capability provided by some contractor other than the one bidding on the system (must always be preceded by a. or b.);

d. A cost less than any of the above which would reflect what the activity would apy to get this capability (must be preceded by a., b., or c.); and

e. The worth of each feature must be calculated for each year of the systems life.

The lowest worth derived above becomes the value of the feature.

3. Templet - tells how the worth or value derived is to be distributed.

4. Valuation - is actually done on a separate standard form which is attached to the value statement sheet. (A sample value statement is shown in Figure 5.)

The Selection Plan also defines how the costing of the vendors proposal will be accomplished. It is at this point that many of the previously mentioned elements start coming together, e.g., the workload levels, extension factors, time required to execute a benchmark, etc. The cost of money is introduced at this point. There is a requirement to perform an economic analysis of the cost.[14] Currently the discount rate in use is 10 per cent.

An example of the formula used to define the cost of a system is shown below. The basis for this example is the workload levels and probabilities

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[14]U.S., Department of the Navy, "Economic Analysis of Proposed Department of the Navy Investments," Comptroller of the Navy Instruction 7000.28 (April 19, 1967) Department of the Navy, Washington, D.C. 20390.

VALUE STATEMENT

DESIRABLE FEATURE: Capability to expand at year 2, the systems at the three activities to include time sharing systems for program testing purposes.

RATIONALE: "Time Sharing Versus Batch Processing: The Experimental Evidence" by H. Sockman, 10 October 1967, AD 661-665, Defense Documentation Center publication, reports that a 25% reduction in program development time has been shown in experimental studies by using time-sharing techniques instead of batch processing techniques in testing. Time-sharing caused a 40% increase in computer test time. No significant differences were found in program size or run time. On this basis, the following cost reduction would be gained from time-sharing:

25% of all programmers' yearly salary - 40% X hourly computer rental rate X hours test time per week X 52 weeks per year = cost reduction/base.

Taking number of programmers at each branch = 20

Programmer yearly salary = $20,000

Hourly computer rental rate = $100

Average hours test time per week = 20

Then (.25 X $20,000 X 20) - (.40 X $100 X 20 X 52) = cost reduction per year for one activity.

$100,000 - $41,600 = $58,400 yearly savings per activity
X3 activities
$175,200 total per year
X4 years
$700,800 total savings

TEMPLET: If proposed, a value of $58,400 would be given for each activity per year for each year after the first year.

SOURCE: E.O. Joslin, "Competitive Computer Selection Within the Department of the Navy," unpublished paper presented to the Diebold Group Inc., October 1969.

Figure 5 — Sample Value Statement

shown on page 28. In this case, there is a 90 per cent chance of the workload being at Level 1 for the first twelve months, and there is a 5 per cent chance this will be the case in the second twelve months. This same type of analysis is performed for all of the other workload levels. Based on this data the costing formula is then developed. The formula for the first workload level would be:

$MC_{wl\ n}$	=	monthly cost workload level n
Y	=	number of months
P	=	probability of operating at $_{wl\ n}$
D	=	discount rate

$$YMC_{wl\ n} \cdot P \cdot D + YMC_{wl\ n} \cdot P \cdot D$$

$$12MC_{wl\ 1} \times 0.90 \times 0.91 + 12MC_{wl\ 1} \times 0.05 = 10.33MC_{wl\ 1}$$

By performing the same mathematical operation to the other workload levels, the present worth of total expected lease payments for each configuration can be expressed as:

$$10.33MC_{wl\ 1} + 10.00MC_{wl\ 2} + 8.56MC_{wl\ 3} + 7.75MC_{wl\ 4} + 6.89MC_{wl\ 5} + 1.89MC_{wl\ 6} + 0.37MC_{wl\ 7}$$.[15]

The Selection Plan is now complete. The SSEB presents the RFP and the plan to the Source Selection Advisory Council for approval. When this review is completed and approval is granted, the RFP is forwarded to the suppliers.

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[15]U.S., Department of Defense Computer Institute, Report of the Fourth Computer Selection Techniques Seminar (Washington, D.C.: February 18-19, 1969), p. 8.

Vendor Liaison and Validation

The amount of effort that has to be devoted to this function is inversely related to the degree of excellence in the RFP. The period of time is normally four months. Essentially all that is required of the Navy personnel is to be available to answer vendor questions, and to be ready to witness the running of the benchmark programs when the vendors are ready to demonstrate them.

There is one cardinal rule in vendor liaison: whatever is told or applies to one vendor must be told to all vendors, and in writing. This rule is considered essential—it is often difficult to differentiate between liaison and negotiation. It is also necessary in order to avoid later difficulties which can arise when all bidders are not equally informed.

Proposal Evaluation

Evaluation of the vendors proposals is not a simple task if, however, the RFP and Selection Plan is properly prepared the degree of difficulty will be reduced considerably. The actual steps included in the evaluation process are:[16]

1. Reading and understanding all proposals.
2. Verifying that all mandatory conditions are satisfied. If a proposal does not satisfy all manditory conditions it is ruled not responsive and it is no longer considered.
3. Determining the degree to which the requested desirable features have been provided.

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[16]Joslin, "Competitive Computer Selection," p. 29.

4. Matching the response to the desirable features with the value statements.
5. Costing the vendors proposal.

The verification of vendor claims is often difficult. To assist in this, the RFP requests the vendors to reference the technical manuals. If the SSEB cannot verify a claim by using the technical manuals or other references, the capability in question is regarded as a vendor's promise and it is incorporated as a term and condition in any resulting contract.[17]

Determining the degree to which a desirable feature is satisfied and matching this with the value statement is also a difficult task. "It can result in many bruised egos, but normally it can be worked out to the satisfaction of all."[18]

The pricing or costing of the life of a system is an involved process. The total cost is dependent on many elements: the number of years the system will be used, the number of hours the equipment will be used, the cost of the desirable features provided by the vendor, the cost of satisfying a desirable feature by an alternate means if the vendor does not provide the item, the cost of vendor support, etc.

Another complicating factor is that each of these costs have to be considered under several different procurement possibilities: lease, lease with purchase option, purchase, and any special procurement plan which may be worked out with vendors.[19] In addition and as previously mentioned, an economic analysis using the present value technique must also be included in the calculations.[20]

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[17] Ibid.

[18] Ibid.

[19] Ibid., p. 31.

[20] NavCmptInst 7000.28.

Negotiation and Contract Award

The SSEB review of the vendor proposals, is attended by a continuous search for items which might be negotiable. An example is an item offered by one vendor at no cost might be obtainable free from the other vendors if the item was subjected to negotiation. Usually such items as training, maintenance, and some software packages fall into this category.

After the SSEB has defined which proposals are responsive to the requirements of the RFP, letters are prepared and sent to the vendors. The purpose of this letter is to set up the time and place for negotiation sessions with the responsive bidders. In addition the letter tells the vendor what items the Navy wishes to negotiate with the vendors.

At the negotiation session, the vendors and Navy personnel discuss the items in question. The vendor is told when to submit the final proposals. These proposals, however, must be based on the original proposal plus information covered in the negotiation sessions. Each of the contractors is encouraged to improve his proposal, and they are reminded to submit them by the scheduled date because late proposals might not be considered. The session is then closed, and a memorandum of the meeting is prepared and becomes a part of the contract pre-award file.[21]

When the proposal changes are received, the SSEB again reviews the proposals

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[21]Joslin, "Competitive Computer Selection," p. 32.

and adjusts the cost data based on the changes received. The evaluation then determines the proposal representing the lowest overall cost to the Department of the Navy. The selected proposal is nominated to the SSAC and to the Special Assistant to the Secretary of the Navy (SASN).

When the SASN approves the selection, three copies of the contract are sent to the vendor for signature. If the supplier disagrees with some aspect of the contract, the point is discussed and resolved. The vendor's representative and the government contracting officer then sign the contract.

Occasionally there is one other step. If the award is for more than $1,000,000, ADPESO does not announce the award for at least twenty working hours after notifying the Office of Legislative Affairs. The purpose of this hold is to allow the appropriate Congressman to be told of the award.[22]

There are several other actions that are initiated at this time. An announcement of the award is sent to the Commerce Business Daily for public announcement via that media. Letters are sent to the unsuccessful bidders indicating that their proposal was not selected however their future interest is solicited. This letter also provides the unsuccessful bidder an opportunity for a post-approval meeting with ADPESO. If any unsuccessful bidder desires such a meeting a written request has to be sent to ADPESO within ten days. There are several guidelines established

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[22]Ibid., p. 33.

governing the conduct of these post-approval meetings:

1. No informal sessions with respect to approved equipment selection shall be held with any unsuccessful supplier, nor shall any oral information be furnished on the subject.

2. All questions from an unsuccessful supplier shall be provided to ADPESO in advance and in writing, and should be as specific as possible. The DON reserves the right to reject irrelevant or immaterial questions. Conversely, related and relevant questions which are obviously and naturally evoked by responses to previously submitted questions may be entertained within reason. In this regard, however, the normal provisions apply with respect to security sensitive information and proprietary information.

3. The judgement exercised in the application of selection criteria to particular proposals is properly a matter wholly within DON purview.

4. Post-approval meetings shall be held as soon after they are requested as practicable.[23]

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[23]SecNavInst 10462.13, p. III-9.

CHAPTER IV

ALTERNATIVE SELECTION SYSTEMS

To assist prospective users, today there are a number of different methods used in determining which computer system best satisfies the data processing requirements of the organization. Some organizations select their computers by soliciting competitive bids while others select a system without seeking any vendor competition. When competitive bids are requested the criteria used to determine the best system ranges from objective standards to subjective judgement. The purpose of this chapter is to review the various current practices and explore the details of some of the systems used.

Survey of Computer Selection Practices

Dr. Norman F. Schneidewind of the Advanced Systems Division, Systems Development Corporation, conducted a survey for Datamation and the results were subsequently published in the magazine.[1] The data was obtained by sending

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[1]Norman F. Schneidewind, "The Practice of Computer Selection," Datamation, 13.2 (February 1967), pp. 22-25.

questionnaires to four types of computer users. The types of users and the number responses from each were:

1. Commercial: Non-government, non-aerospace, non-university	37
2. Government: Civilian, military, federal, state, local	20
3. Aerospace: Aircraft, missle, space	8
4. University	4
Total responses	69

The survey questionnaire was directed toward four aspects of the computer selection process. The areas covered and the findings of the survey are as follows.

Competition

The competition section of the questionnaire was designed to determine whether the selection process takes place on a competitive or sole source procurement basis. The responses indicated that between 77 and 92 per cent of all users utilize competitive selection systems. The degree to which the various users rely on the competitive process is shown below.[2]

Government		94.4%
Non-government		80.9%
Commercial	80.6%	
Aerospace	85.7%	
University	75.0%	
Total All Users		84.6%

Dr. Schneidwind determined that in general it was the user with a small installation (average monthly rental of $16,800) that used single source procurement, while the

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[2] Ibid.

management of larger installations (average monthly rental of $62,300) select their equipment based on a competitive bidding system.

Methods

The purpose of the methods section of the questionnaire was to determine which of the following selection methods are used. The methods are listed with the one considered by Dr. Schneidewind as the most objective first while the last was considered to be the least objective:

- Computer Simulation
- Mathematical Modeling
- Program and Execute Test Problems
- Evaluation of Benchmark Problems
- Published Hardware and Software Evaluation Reports

It was found that larger installations use more objective methods than small installations. The specific findings are given below.[3]

	0 to $15,000	$15,000 to $50,000	$50,000 and Up
Benchmark Problems	50.0%	81.8%	76.9%
Evaluation Reports	80.8	77.3	53.8
Test Problems	53.8	54.5	61.5
Simulation	7.7	13.6	46.2
Modeling	0	4.5	30.8

[3] Ibid.

Selection Criteria

The respondents were asked to rank the following computer selection criteria in order of importance:

Hardware performance
Software performance
Support provided by manufacturer
Availability of application programs
Compatibility with present hardware and software
Delivery date
Potential for growth (modularity)
Cost

The user was asked to rank these items by assigning the number one to the most important, the number two to the next most important, etc. According to Dr. Schneidewind the most objective criteria are hardware and software performance, while the least objective are availability of application programs and manufacturer support.

The results indicate that all users place more emphasis on the objective (hardware and software) criteria than on the subjective criteria. Dr. Schneidewind considered this to be the most significant finding of the survey. In addition the results indicate that commercial users rated cost as a less important criteria than did the other users. The average rankings are shown below.[4]

	Commercial	Government	Aerospace	University
Hardware	3.11	2.15	1.57	2.50
Software	2.73	2.45	3.68	1.75
Manufacturer Support	3.92	4.32	5.29	3.50
Availability of Programs	6.57	7.30	7.14	6.75
Compatability	4.35	4.85	3.86	6.00
Delivery	6.27	6.45	6.43	7.25
Growth	4.68	4.25	5.57	4.50
Cost	4.38	4.25	2.43	3.75

[4] Ibid.

Outside Assistance

The intent of this section of the questionnaire was to determine the extent to which users depend on outside assistance in the selection process and when they did what type of consultant was used. Specifically the respondents were asked to indicate which of the following types of outside assistance were used:

Independent Consultant

Accounting Firm

Management Consultant

Technical Firm

Computer Manufacturer

The findings indicate that the number organizations using outside assistance is small, and the organizations that do use consultants generally have small data processing installations. When outside assistance is used the computer manufacturers are relied on more heavily than the others.

Based on the analysis of the data accumulated in this survey, Dr. Schneidewind developed what he considered to be a typical computer selection process. In general, computer selection is competitive, objective criteria is stressed, and the selection is performed in-house rather than by an outside consultant.

Review of Specific Alternative Systems

The process of selecting a computer from among several alternative proposals logically breaks down into two major parts. The first part consists of the validation of the vendor's claims. The validation process is concerned with verifying the capabilities of each system proposed and the estimated system times required by each configuration to complete the workload. This is a very important part of the selection process. The user must be aware of the old saying "buyer beware." While the vendors will probably not perpetrate a falsehood the buyer must understand that the proposal is a selling device and certainly each vendor wants to look better than all others. In order to look best, the vendors will interpret the specifications in a way that is favorable to their equipment. The amount of interpretation is related to the way the requirements are set forth in the specifications of the RFP. If the specifications are loosely worded then the suppliers are put into a situation that requires a great deal interpretation of the specifications to make a proposal. An example of the types of problems that can arise if the proposals are not thoroughly validated against the organizations requirements is the situation at United Airlines and Trans World Airlines:

> Two of the largest commercial computer systems ever ordered—for reservations at United Airlines and Trans World Airlines—are not working out. United has decided to drop its Univac system, estimated to be valued at more than $30 million, while TWA reportedly is close to canceling an equally large system ordered from Burroughs Corp. According to United, the Univac system was more than a year late and still inoperative. Industry sources report that delivery

problems in hardware and misunderstandings over programming tripped up Burroughs and TWA. Both airlines will continue to use their existing computers until they select suppliers for a third-generation system.[5]

The second half of the selection process is the evaluation of the proposals that satisfy all of the basic data processing requirements. The purpose of the evaluation is to differentiate among the various proposals and find the one that best satisfies all the selection criteria.

There are several methods, besides the ones used by the U.S. Navy, that can be used in the validation and evaluation of system proposals. The rest of this chapter purports to examine some of the alternative validation and evaluation systems.

Alternative Validation Methods

Two areas of each proposal must be validated: system capabilities and system timing.

Capabilities

The user can verify system capabilities in several ways. First, all the manufacturers technical literature can be read. The next step is to compare this data with the vendors proposal. An alternate way would prepare a detailed

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[5]"Airline Computer Problems," Business Week, February 7, 1970, p. 34.

questionnaire to be included in the RFP and request the suppliers to provide the requested data. The vendors proposal is then compared with this data. A third way of obtaining this information is to study the Standard EDP Reports prepared by the Auerbach Corporation.[6]

Timing

The validation of system timing is a most important task. In addition, it is a difficult task to accomplish, particularly with a high degree of accuracy. The importance of this operation however, can not be overemphasized. The timing estimates derived will serve at least two vital functions in the selection process. First this information will be used to determine if the proposed configuration can perform the stated workload. Second, the timing data will provide the foundation for costing the proposal.

There are several ways to verify the timing of computer systems: benchmarks, computer simulation, and detail hand timing. The use of benchmarks was described in Chapter III.

Simulation

Simulation is a technique in which a model of the actual system is described and constructed and testing of the real system is accomplished by exercising the model.

[6]Edward O. Joslin, Computer Selection (Reading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1968), p. 67.

The function then of a simulation model is to show the results created when certain things happen under the control of a set of decision rules.[7] The limitations and the advantages of simulation are stated by Teichroew and Lubin:

> Simulation problems are characterized by being mathematically intractable and having resisted solution by analytic methods. The problems usually involve many variables, many parameters, functions which are not well behaved mathematically and random variables. Thus, simulation is a technique of last resort. Yet, much effort is now devoted to "computer simulation" because it is a technique that gives answers in spite of its difficulties, costs and time required.[8]

There are several computer-simulation techniques in use or under development; however, the system most widely known and used is one called SCERT (Systems and Computers Evaluation Review Technique).[9] SCERT has the capability to simulate over 100 different computer systems manufactured by the thirteen different companies companies. A complete list is shown in Appendix G. SCERT divides into four major components: definition languages, a factor library, simulation programs, and output reports.[10]

The definition languages are used to define the applications systems to be simulated and the hardware/software complexes to be simulated. Several

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[7]John E. Cremeans, "The Trend in Simulation," Computers and Automation, January, 1968, p. 46.

[8]Daniel Teichroeu and John F. Lubin, "Computer Simulation-Decision of the Technique and Comparison of Languages," Communications of the ACM, IX (October, 1966), p. 724.

[9]Joslin, Computer Selection, p. 86.

[10]A Technical Description of SCERT (Rockville, Maryland: Comress, Inc.), pp. 17-49.

language section components facilitate this. The data definition division defines the files and reports of the applications system. The procedures division defines each application program. The configuration division defines each equipment configuration to be simulated, including model number and quantity. The environment division defines the staff that support the installation plus salary level.

The factor library contains the characteristics of the hardware and software items—characteristics such as cost, performance and technical specifications. This data is obtained by Comress from the manufacturers.

The simulation programs perform the processing necessary to accept the input definition data and create the output reports. The programs are used in five phases which will be discussed later.

The output reports consist of fifteen different reports. All reports are not created for each evaluation; for instance, the real-time reports would not be produced when a batch processing system is being simulated.

The entire SCERT operation is shown as Figure 6. As can be seen there are five functional phases.[11]

- Phase 1 - The Introduction of Processing Requirements

The first input to SCERT is a series of definitions outlining the workloads and computer processing requirements of the system to be simulated. Specifically the information entered is concerned with three areas.

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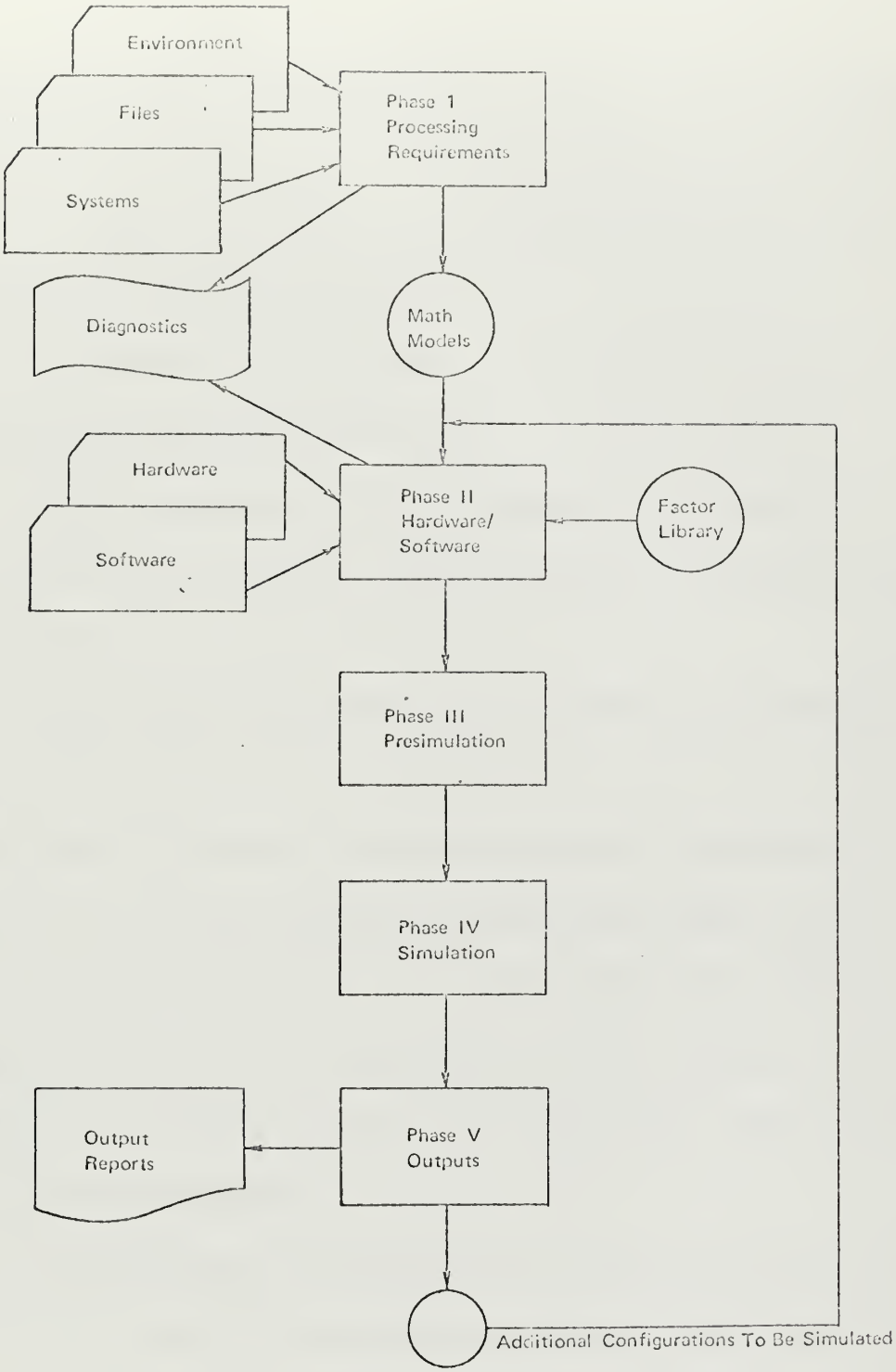
[11]Unless otherwise footnoted, this and future information relating to SCERT was was generally obtained from A Technical Description of SCERT (Rockville, Maryland: Comress, Inc.).



SOURCE: A Technical Description of SCERT (Rockville, Maryland: Comress, Inc.), p. 16.

Figure 6 — The SCERT Program

Systems Environment information relates to the environment in which the computer and data processing system will operate. The detail data elements are:

Cost Data - Specifies the costs of operation such as programmer and operator salaries, and systems life expectancy.

Programmer Experience Profile - the user indicates the experience and qualifications of the programming personnel.

Definition Percentiles - the user indicates the percentage of the total system requirements not defined for analysis by SCERT. The simulator uses these to project the total.

Real Time - the parameters concerning real time processing, if any, are entered.

File Definition defines each file in the data system. Each file is given a unique number; the size of the file is specified by indicating the number of records; the number of characters and fields per record and the type of file is indicated.

Systems Definition is the common denominator for defining the processing requirements in the individual computer run or random event. Each run definition consists of three distinct levels:

Run identification, frequency, priority, and prerequisites. Each run is defined by a unique number and the frequency is indicated as daily, weekly, monthly, quarterly, or yearly.

File identification and through-put parameters. Each file is defined by the

unique number used in the file definition above. Any special considerations concerning the way the data is to be handled is indicated.

The internal activity section provides the simulator with the internal processing applicable to the input and output files.

Phase 1 has three primary functions:

- Accept the input definitions indicated above;
- Build a mathematical model of each computer run; and
- Validation of the model and output diagnostic data if any errors or inconsistencies are found.

o Phase 2 - The Introduction of Hardware/Software To Be Simulated

In Phase 2 the specific hardware and software configuration being appraised is introduced. This is a very specific and detailed definition of the hardware. The model numbers of every component, all special features, adaptors, number of channels, etc. to be used have to be provided. In addition, the details applicable to the software package have to be indicated.

The functions of Phase 2 are:

- To accept the hardware/software definitions;
- To build a mathematical model representing hardware/software; and
- To validate the compatibility of the models built in Phase 1 with Phase 2 models. If discrepancies are found, a diagnostic report is created.

o Phase 3 - Presimulation Algorithms

In this phase the models built in Phase 1 are passed against the models of Phase 2. During this processing a series of calculations are performed which in effect structure and parameter the non-hardware oriented models to the performance abilities and capabilities of the hardware.

During Phase 3 the following events for each program occur.

- . The internal processing time and memory requirements are calculated.
- . All files are assigned to I/O devices and channels.
- . All files are structured to meet the hardware parameters.
- . The thru-put time for all I/O and memory functions is determined.
- . The timing of the software packages is determined.
- . The pre- and post-run times for factors such as setup-time, error-correction, etc. are calculated.

o Phase 4 - Simulation

In this phase the actual simulation of the system takes place. All of the work performed in the first three phases was in preparation of the data for input to Phase 4. There are three distinct stages:

Stage 1 - Each program run or random event is expanded into its maximum number of unique thru-put iterations. The processing simulates the flow of each of these thru-put iterations through the computer configurations. The results are the net thru-put timing.

Stage 2 - This stage is entered only if the defined processing includes random-occuring events. This stage constructs models based on probability theory and distributes the occurrences of events in a probabilistic manner. These models are then simulated and potential queueing points are determined, and processing delays caused by the queues are derived.

Stage 3 - This stage is entered whenever the hardware/software complex is capable of multi-programming or multi-processing. In the first two stages the net elapsed time and capacity requirements were developed. It is the function of Stage 3 to schedule the concurrent processing of these events. When this is completed, the results stored in the mathematical models is ready to be printed out.

- Phase 5 - Production of Output Reports

SCERT can provide the user with fifteen standard reports. If requested the simulator can be modified to provide nonstandard or special purpose reports. The reports that are of particular interest in validation are given below. A complete list of the standard SCERT reports is shown in Appendix H.

Computer Complement Report—Portrays the exact configuration that was simulated and provides certain basic cost data about the configuration.

Central Processor Utilization—Summarizes for each scheduled run the projected running time and horizontal memory utilization.

Cost Summary—Primary cost output which relates the projected utilization of the computer to lease, purchase, and maintenance cost considerations.

Detail Analysis—Produced for each scheduled run or real-time event simulated and serves as backup for all other reports. It precisely portrays the utilization, timing, and memory requirements derived by the simulation and presimulation algorithms for all components making up the run.

Hand Timing

The essence of hand timing is to analyze each and every function that the computer system will be required to perform during the running of a program. The hardware engineering time for each operation is determined and all of these times are added together to derive the program running time.

This method of timing requires the user to have a detail knowledge and understanding of the programs that are going to be timed. In addition, a standardized method of gathering the required data should be used. This is necessary in order to obtain consistency between vendors and limit the number of approximations in the timing data. Some suggested timing tables are proposed by Joslin.[12] There are several data elements that should be in a detail time table:

- Program Number and Frequency
- Input/Output Requirements
- Central Processor Memory Requirements
- Non-productive Time
- Productive Time for Each Component

In addition to a detail sheet the user should have a summary sheet. On this form the user can enter the data from the detail sheets. From this data the user can then determine the monthly run time.

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[12]Joslin, Computer Selection, p. 83.

Alternative Evaluation Methods

The purpose of the evaluation process is to define which of the several proposals submitted is best suited to the organizations needs. Determining which is best forces the user to establish some criteria that can be used as a yardstick to measure the proposals. The objective of evaluation is usually to select a proposed ADP system, capable of accomplishing the future workload at the lowest total cost.

There are several different ways for evaluating the proposals. The alternatives range from a policy of not rocking the boat and staying with the current supplier to the very competitive situation that uses objective criterion in the selection process. In order to serve the purposes of this paper only the systems considered to be objective will be reviewed.

The literature search for this paper revealed three different objective methods for the evaluation of vendor proposals: Weighted Scoring, Cost-Effectiveness, and the Cost-Value techniques. Cost-Value was reviewed in Chapter III.

Weighted Scoring

There are several different weighted scoring systems that can be used.[13]

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[13]For the interested reader: Eugene S. Schwartz, "Computer Evaluation and Selection," Journal of Data Management, VI, No. 6 (1968), pp. 58-62; and, J.A. Campise, "A Quantitative Approach to Equipment Comparison," Journal of Data Management, I, No. 5 (1963), pp. 12-20.

For this paper, the system proposed by Mr. Solomon Rosenthal will be reviewed.[14]

The first step, when using a weighted scoring system, is the establishment of the selection criteria. The basis for developing this plan is the systems specification of the information system. The user must define those characteristics of an ADP system that will be required to satisfy the needs of the organization. The specific items included and the relative weight assignment to each item varies based on the requirements of the information system. In Mr. Rosenthal's system, the factors are classified as major, intermediate, or minor.

The major categories include factors such as: overall costs, equipment characteristics, systems potential, vendors support and others as required. The intermediate and minor categories would include the component elements that make up the major area. For example, within the cost element, details would focus on the cost of individual components and features of each. In addition, costs relating to the installation of the equipment and its subsequent operation would also be considered in the intermediate or minor categories.

The next step is to assign weights to the factors to be used to evaluate the proposals. It is important to note that if this system is to be impartial, the weights must be assigned before any vendor proposals are received. In fact, the weights should be assigned before the RFP is circulated. The maximum score possible is

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[14]Solomon Rosenthal, "Analytical Technique for Automatic Data Processing Equipment Acquisition," Proceedings of the AFIPS Spring Joint Computer Conference, 1964, pp. 359-366.

established as 100. This score can be achieved only if one proposal is the best in all factors. A part of the 100 maximum is assigned to each major factor based on the relative importance of each. Then weights are assigned to the intermediate and minor factors. The sum of the weights assigned to the intermediate and minor elements must be equal to the appropriate major factor of which they are a part. The results of this process might look as presented in the following example.

FACTORS		WEIGHTS
Cost		35
Machine Rental	20	
One-Time Costs	10	
Personnel Support Cost	5	
Equipment Capability		25
Random Access Storage	10	
Systems Validity Checks	5	
Processing Speed	10	
System Potential		15
Ability to Increase Random Storage Rapidly	10	
Ability to Augment Central Processor	5	
Manufacturer Support		10
24-Hour On-Site Maintenance	5	
Back-up in Vicinity	5	
Common Language Programming		10
COBOL	5	
FORTRAN IV	5	
Physical Requirements		5

After the proposals are received and validated, they are ready for scoring. It should be noted that when using this system the individuals involved in the validation of the proposals do not do any scoring. The scoring is accomplished by a completely different group of people. In addition, the scorers do not know which vendors'

proposal they are processing. In fact, the scorer does not even see the proposals. The scores are recorded on an evaluation sheet that was prepared in the validation process. The evaluation sheet shows the data applicable to each factor. In addition, the validators prepare a written report indicating the costs, processing times, and differences between the proposals and the specifications.[15]

Based on this information, the scoring begins with the minor elements first, then intermediate scores are developed, followed by the majors and finally the grand total. The minor scores are developed by either of two methods. Some minor factors are not compared one proposal with another, but are assigned a predetermined score if certain conditions exist. For example, if free maintenance is provided twenty-four hours per day, "X" points might be awarded, if only for eight hours per day, a lessor score would be assigned.

The second method would apply to the majority of the minor elements. If the smallest is best, the score is computed as follows:

$$\frac{\text{(comparison base) (maximum possible)}}{\text{(this vendor entry)}} = \text{minor score}$$

If the largest is best, the following formula is used:

$$\frac{\text{(this vendor entry) (maximum possible)}}{\text{(comparison base)}} = \text{minor score}$$ [16]

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[15] Ibid.

[16] Ibid.

The next step is to total the minor scores within each intermediate. The intermediate scores are added together to form the major scores and the final score is the sum of all the major scores.

The proposal then with the highest score would be recommended to top management as being the best system to select.

Cost Effectiveness

The concept of cost effectiveness is primarily attributable to the work of Hitch and McKean,[17] and the principles of this concept provide the foundation for a computer selection system developed by the Mitre Corporation. Prior to analyzing this system however, it will be helpful to define the words cost and effectiveness.[18]

> Effectiveness - The degree to which a system will perform the future jobs and satisfy the constraints. Effectiveness is generally considered to consist of the following three main components. . . .
>
> a. Capability - The degree to which a system will perform the future jobs and satisfy the constraints, assuming that the system is always available for operation and will never malfunction. Capability can be measured in various ways but the two key measures of capability are:
>
> (1) Quality of the work output. This measure is in general multi-dimensional since it encompasses the many sub measures used to measure the work output. For example, it might include the straightness of a line of print or the maximum number of copies of printout.

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[17] Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age (Cambridge, Mass.: Harvard University Press, 1963).

[18] J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection (Springfield, Virginia Clearinghouse: U.S. Department of Commerce, AD 667-522, October, 1967).

(2) Time. Given that the quality of the work output can be measured, a second key measure of the EDP system capability is the time taken to perform the future work load, again assuming the system is available for and never malfunctions. For example, the measure could be the expected time to perform a given monthly workload.

b. Availability - may be defined as the probability that the system will be ready for operation when called upon.

c. Defindability - may be defined as the probability of the system completing the job satisfactorily, given that it was available. . . .

. . . . . .

Cost - The total dollars required to procure, operate, and maintain the system to perform the future set of EDP jobs. . . .[19]

Since these two elements have been defined it is possible to measure each one separately. The problem then becomes one of combining these two elements in a way to facilitate decision making. To do this it is necessary to specify in advance the level of either the cost or the level of the effectiveness. The mechanics are explained below and illustrated in Figure 7.

Level of effectiveness specified: called pivoting on constant effectiveness. If level E_2 is selected as the comparison level, system A could not be selected. If the effectiveness of A were increased to E_2 its cost would then be at either point A_1 or A_3. Now system A and B can be compared with each other. If the A system cost were A_1 then it would be selected; however, if the cost were at A_3 then the B system would be selected.

Level of cost specified: called pivoting on constant cost. If the C_2 cost level is selected as the comparison level of cost, and the cost of system A is increased, its level of effectiveness moves to either A_2 or A_4. When A's effectiveness and cost

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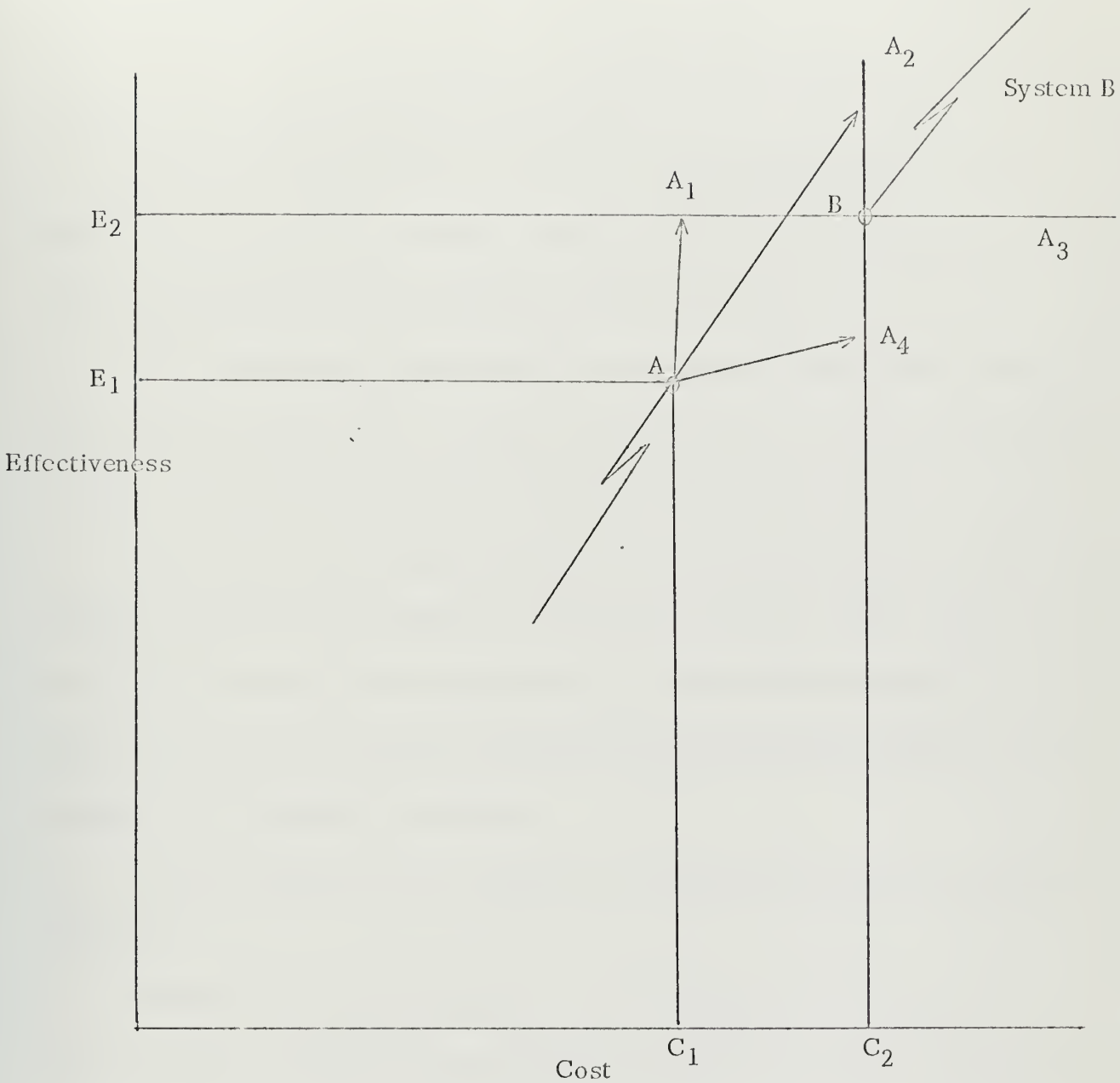
[19] Ibid., p. 13.



SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD 667-522.

Figure 7 — Measurement of Cost and Effectiveness

intersect at A_4 the B system is the better buy. The converse is true when the effectiveness and cost of the A system is represented by the point A_2. In this situation the A system would be the better buy.

The first selection criterion, pivoting on constant effectiveness, is more applicable to the problem of computer selection, so the cost-effectiveness system devised by Porter and Rudwick is based on this principle.[20]

There is a great deal of similarity between the cost-effectiveness system and the cost-value system used by the Navy. Both methods are based on: a probabilistic workload projection, mandatory requirements, and desirable features.

There are differences, however, in the way the projected workload is derived and in the way that value is calculated for the desirable features. Both systems however regard the mandatory items in the same way. The mandatory features are validated and the requirements in the RFP concerning these items must be satisfied for the proposal to be considered responsive.

The total selection process using the cost-effectiveness system is shown in Appendix I.

Probabilistic workload projection: the basis for using probabilities in projecting future workload is the fact that the user can predict with a high degree of confidence certain "known jobs"; however, there are "likely jobs" which can only be expressed quantitatively with a lower degree of confidence.[21]

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[20] Ibid., p. 17.

[21] Ibid., p. 18.

The user prepares a projection of his future workload by starting out with a diagram similar to the one in Figure 8. The lowest line is called the "Reference Workload" and the user has indicated that there is a 100 per cent probability that this workload level will be experienced or exceeded. The user then assigns a probability to each of the other workload level projection lines.

The next step is to average the yearly workload levels. This, then, permits a diagram like that shown in Figure 9 to be drawn. The purpose of this is to simplify the cost calculations.[22]

In the validation phase, timing data was developed for each system proposed. This information is correlated with the various workload levels. If benchmarks were used this correlation is accomplished by using the extension factors.

The evaluation team can now construct a chart similar to the one shown in Figure 10. In this situation the RFP had a mandatory requirement that the workload be completed in 600 hours. In view of this, Vendor A has proposed two systems: A_1 and A_2. System A_1, a cheaper system, can satisfy the mandatory requirement until sometime in the third year of the system life. Then it is augmented to become system A_2, which can satisfy the 600 hour requirement for the remainder of the system life.

It will be noticed in Figure 10 that the method of expressing the probability is different. The figures now represent the probability of the workload falling within the respective segments.

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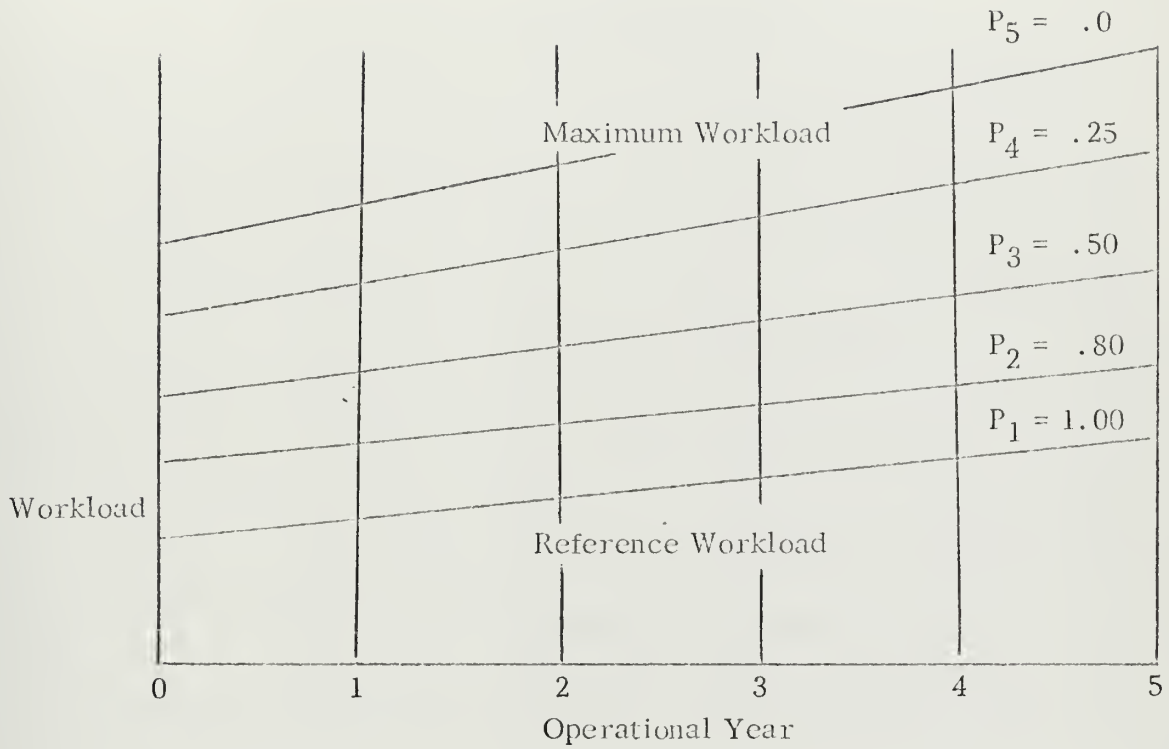
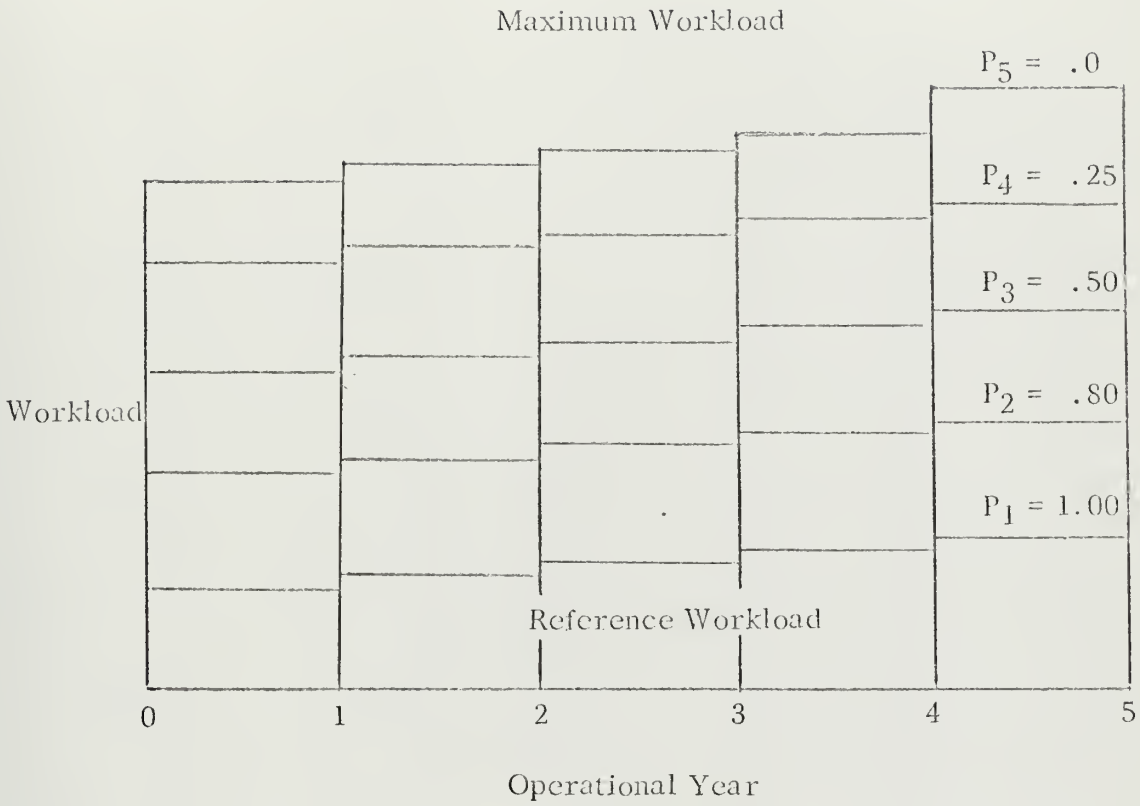
[22]Porter and Rudwick, Cost Effectiveness, p. 23.



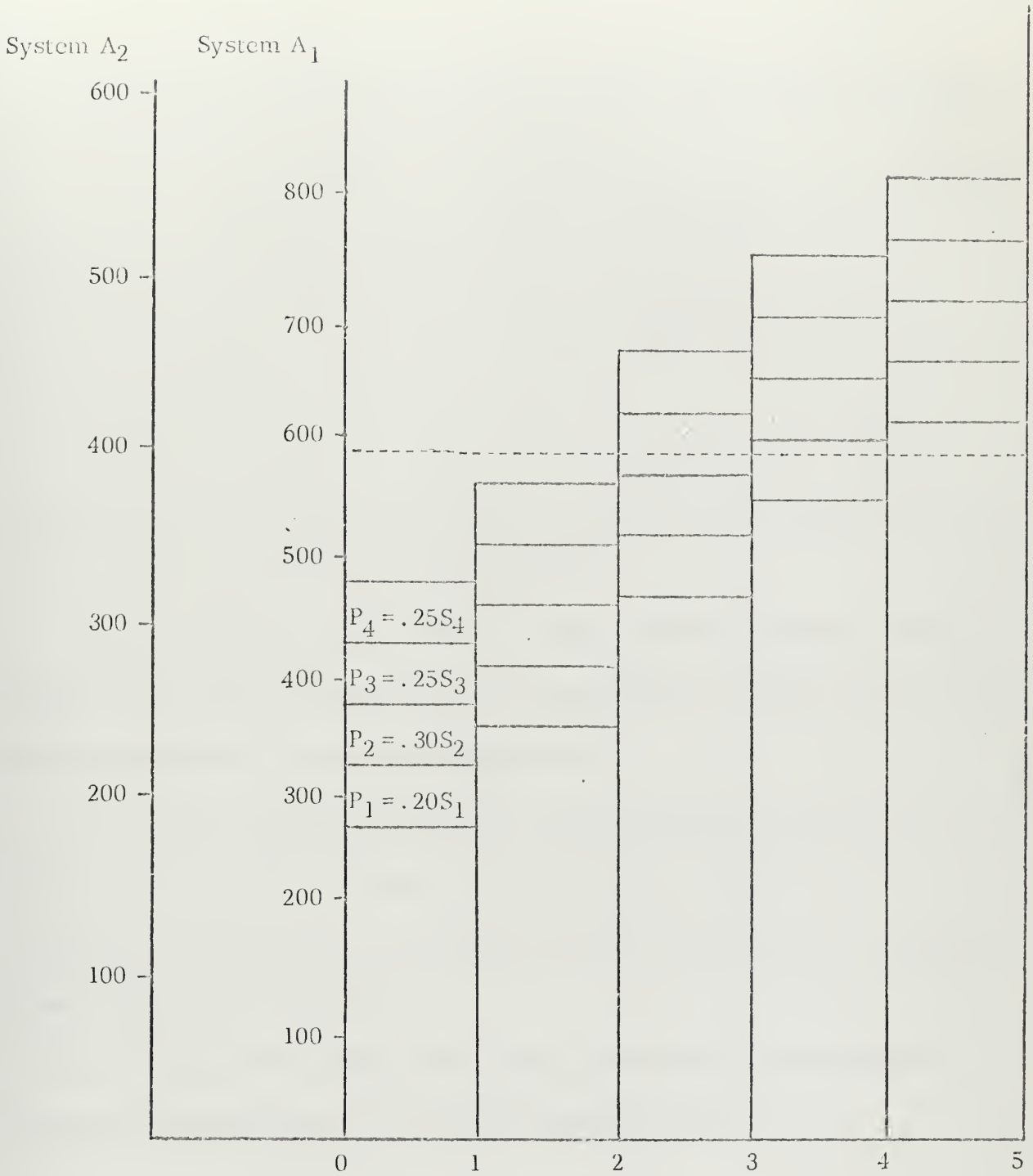
SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD 667-522.

Figure 8 — Probabilistic Workload Projection Smoothed Over Time



SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD 667-522.

Figure 9 — Probabilistic Workload Projection Averaged Per Year



SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD 667-522.

Figure 10 — Projected Time for System A_1 and A_2 Proposed By Vendor A

The cost of each system can now be calculated. This is done by determining the yearly cost of operating each system as follows:

$\bar{C}$ = Total Cost

P_1 = Probability of workload in segment 1

C_1 = Cost of operation in segment 1

$$\bar{C} = P_1C_1+P_2C_2+. \ . \ . \ .+P_nC_n$$

After the yearly cost is determined the total discounted present value is derived in a manner similar to the one shown in Appendix J.[23]

Desirable features make up the third category of the user's data processing requirement. Porter and Rudwick are concerned with the necessity of this third way of expressing data process requirements because:

1. The representative workload only approximates the actual workload. Since there may be other workload requirements that will not be measured in the systems timing determination, by including desirable features the user is provided a hedge against this uncertainty.

2. The inclusion also provide a hedge against the uncertainty attendant to measuring a systems ability to perform the future workload.[24]

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[23]U.S., Executive Office of the President, Bureau of the Budget, Discount Rates and Procedures to be Used in Evaluating Deferred Costs and Benefits, Circular A-94, Washington, D.C., Attachment A.

[24]Porter and Rudwick, Cost Effectiveness, p. 18.

3. The use of desirable features permits a reduction in the number of mandatory requirements. By definition the vendor must satisfy all mandatory items or his proposal is eliminated. This could create an undesirable situation. For example, suppose the RFP contained a mandatory requirement for the proposed system to have a two second response time. Vendor A's system has a response time of 2.1 seconds, but that system costs 20 per cent less than all others. It is difficult to defend the need for that additional one-tenth of a second advantage, particularly in view of system A's cost.

4. The manufacturers of data processing equipment are competing with each other. This spawns technological innovations which improve the design of computers and the attendant software. The use of desirable features in the RFP provides the vendor an excellent avenue for proposing these advances to the user. Without these features the user would be denied the opportunity of evaluating these advanced capabilities.

Once the desirable features have been stated it is then necessary to provide a way to evaluate the vendor proposals. There has to be a way to relate the characteristics of any particular desirable feature to the job or jobs that will be improved by the use of this desirable. The question then simply stated is: Is the desirable feature offered by the vendor worth the price he charges? This question cannot be answered unless a value of this worth has been assigned. In order to assign a value, however, the term worth has to be defined. In this system, the worth of a feature is equal to

"the lowest incremental cost to do the same job if the feature is not available."[25]

There are two ways provided for determining and evaluating the worth of any desirable feature. The first way determines worth through an analytical process and the second method makes use of comparative ranking.

Analytical determination of worth: Since the worth of a feature is defined as the lowest incremental cost of doing the job if the desired feature is not available from the suppliers, it is necessary to first identify the alternative ways of doing the job. Figure 11 depicts the alternatives that are available to the user. The next step is to determine the cost over the life of the system of alternative ways of accomplishing the function. The worth of the feature is the least of these costs.

It is also necessary to identify the cost of the alternative ways of obtaining the feature and doing the job using the feature. For example the feature might be procur procured from other sources or, in the case of software the user might develop the capability using in-house resources.

Based on this compilation of data, it is then possible to determine the way to accomplish the function at the lowest total cost. This is referred to as the "efficient" solution.[26] Restated, the efficient solution is found by determining the lowest cost method of obtaining the feature and doing the job, then comparing this cost with the worth, and choosing the lowest cost alternative.

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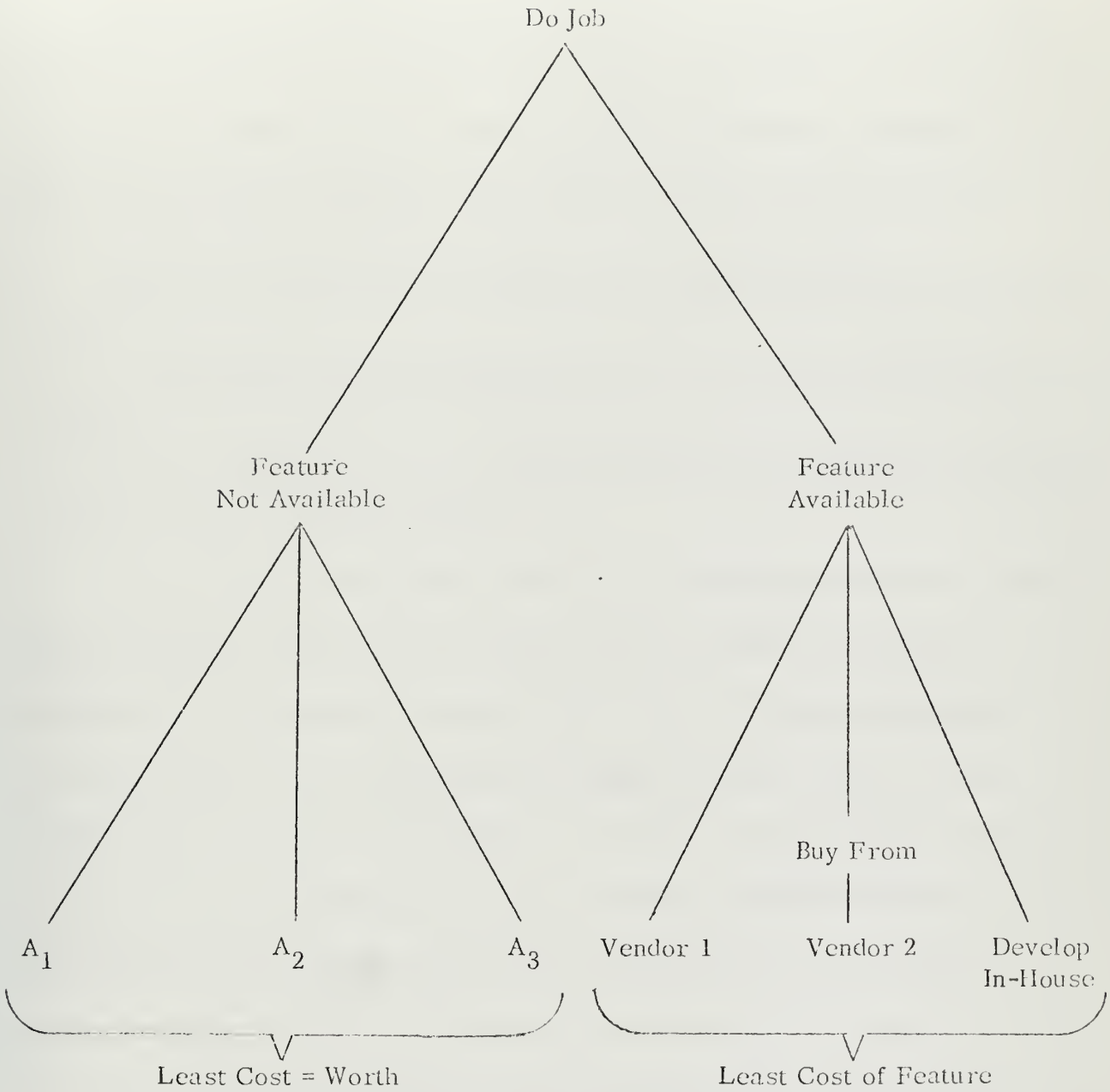
[25] Ibid., p. 33.

[26] Ibid., p. 34.



SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD 667-522.

Figure 11 — Alternatives Available to the User

Determination of worth by comparative ranking: There may be times when it will not be possible to determine the worth of all desirable features by analysis and considered judgement. In these instances, intuitive judgement is substituted as a part of the quantitative evaluation. The steps to implement this procedure are:

(a) All desirable features are ranked in order of importance.
(b) Points are allocated to each feature thus establishing the relative worth of each.
(c) The points are translated into dollars. This is done by calibrating one or more of the features by determining its worth on the analytical basis described above.
(d) The results derived are reviewed using intuitive judgement as the sounding board. If discrepancies are found then either all or some of the items should go through the whole process again.[27]

It is now time to bring together the information derived in the various areas, so that a composite picture of each proposal can be developed. To do this a worksheet like the one shown in Figure 12 will be used. In this example there are three vendors' (A, B, and C) proposals being evaluated. There are three desirable features to be considered—F_1, F_2, and F_3. The users worth and the least cost for each is shown in item 3 on the Evaluator Worksheet (Figure 12). This illustration demonstrates how the costs are derived if the vendor does not provide the feature at all, or the feature is provided in the basic system and cannot be excluded, and finally the instance where the vendor does propose the feature and states its cost.

The initial entry on the worksheet is the Total Proposed Vendor Cost. This

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[27]Ibid., p. 37.

Cost Elements						System Cost		
						C_A	C_B	C_C
1. Total Proposed Vendor Cost						300K	310K	330K
2. Expected Cost to Do Representative Workload						300K	305K	310K
3. Cost of Additional Job Benefits								
	Desirable Feature	User Worth	Least Cost	Vendor Cost C_A	Vendor Cost C_B	Vendor Cost C_C		
	F_1	10K	15K	-	incl	15K	10K	-	10K
	F_2	25K	20K	-	-	5K	20K	20K	5K
	F_3	10K	20K	-	5K	incl	10K	5K	-
4. Total Expected Cost To Do User Job							340K	330K	325K[a]

[a]Vendor C selected - lowest total cost.

SOURCE: J.D. Porter and B.H. Rudwick, Application of Cost-Effectiveness Analysis to EDP System Selection, U.S. Department of Commerce, AD667-522.

Figure 12 — Evaluator's Worksheet

represents the cost of each manufacturers proposed system, if the system is accepted as proposed. It also is the cost as calculated by the vendor.

The evaluator enters the previously derived cost data to process the workload of the life of the system, and thus derives the expected cost to do a representative workload.

At this time the desirable features which each vendor has proposed and the incremental costs associated with each are entered on the worksheet to determine the cost of additional job benefits. In this example note that vendor A does not provide any of the three features. In the case of vendor B, feature F_1 is included in the system cost while F_2 is not provided but F_3 is at the cost indicated. Vendor C has provided all of the features. The cost of feature F_3 however, is not quoted separately but included in the system cost. Now the evaluator can determine for each vendor the least costly of the three alternative ways of receiving the benefits provided by each of the desirable features. The three alternatives are:

a. Buying the desirable feature from the vendor (at the vendor's proposed cost).
b. Obtaining the desirable feature from another source (at the least cost of feature if obtained separately).
c. Not buying the feature, but using the least costly alternative way to provide the benefits (at a cost equal to user worth).[28]

The evaluator now enters the values representing Users Worth and the Least Cost. These values are calculated prior to the actual evaluation process.

The lowest additional user cost for obtaining the desirable feature can be

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[28]Porter and Rudwick, Cost Effectiveness, p. 45.

determined. Note in Figure 12 the cost data entered for the three desirable features. In the case of F_1 the User Worth is \$10K, that is the user can perform the jobs associated with this feature at an expected cost of \$10K. Since vendor A does not provide this feature, the user will be forced to spend \$10K in addition to vendor A costs to satisfy the requirements associated with F_1. Vendor B includes this feature as part of his basic system and the cost of it cannot be segregated. The user then will not have to spend the \$10K if vendor B's system is used. Vendor C can provide F_1 however, the cost is \$15K. Thus, the evaluator would eliminate the feature from vendor C's proposal since its cost is higher than its worth to the user. This same type of analysis is applied to all of the other desirable features.

The total expected cost to the user is then calculated by adding the cost of the desirable feature, or the user cost equivalent, to the expected cost to do the representative workload. This cost completes the cost calculation.

There are some points worth noting concerning this method of arriving at the final cost figures for the proposals. Vendor A had the lowest proposed cost and the lowest cost to perform the representative workload. On the other hand, winning vendor C had the highest proposed cost and the highest cost to perform the workload. These costs however, do not cover all of the users requirements. The total cost is the only one that will provide for satisfying the total data processing requirement of the user. Accordingly the total cost figures are the true criterion for making the decision.[29]

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[29] Ibid., p. 46.

CHAPTER V

EVALUATION OF THE NAVY SYSTEM

It is the purpose of this chapter to evaluate the Navy's competive computer selection system. The review will be conducted by first appraising the organization responsible for selection and then by looking at the various stages in the process.

The Automatic Data Processing Equipment Selection Office

The Secretary of the Navy established ADPESO on 1 July 1967. It is essential to appreciate the role played by this organization if one is going to evaluate the Navy's computer selection system. This becomes abundantly clear when one considers the fact that prior to the establishment of ADPESO there was no one system in use. The selection of ADPE prior to ADPESO was accomplished by the various heads of departmental components. The procedures used varied depending on the philosophy of each of the departmental components. There was widespread use of ad hoc committees that were formed as the need arose. The contracting was conducted by a regular contracting officer, not one specialized in the procurement of ADPE.

The establishment of ADPESO thus accomplished two very significant things. First the responsibility for selection of ADPE was centralized in the Navy. Secondly a full time staff was recruited to carry out the mission of ADPESO.

In addition to centralizing the function, the function was also elevated to a higher level in the Department of the Navy. The Director of ADPESO reports to the Special Assistant to the Secretary of the Navy. Thus, top management attention is always focused on this vital function.

There are twenty-two professional members on the staff of ADPESO. These individuals are responsible for developing the procedures used, plus performing the functions of equipment selection. There are several significant benefits derived from this. First, and probably most significant, is the fact that these individuals are professionals. This means that the breadth and depth of knowledge of each individual presently involved in the selection process is many times greater now than was the case prior to July 1967. This increased knowledge has a very profound impact on the RFP's sent to vendors and the appraisal of the proposals submitted by the suppliers.

In the years prior to the establishment of ADPESO, the specifications and RFP's were prepared by the user activities. The degree to which these specifications were not oriented toward any given manufacturer was dependent on the experience of the individuals preparing them. Since these individuals were normally not involved full time in the selection process, their range of knowledge was limited. In view of this it was possible for the specifications to be oriented one way or another. The full time

professional staff at ADPESO does not labor under this handicap so the package sent to the vendors is not susceptible to this flaw.

When the vendor's proposals are received, the full-time professional staff is responsible for reviewing them. From time to time, user personnel do assist in the appraisal process, but this effort is still under the close control and direction of ADPESO. As indicated in Chapter III, the group actually responsible for preparation of the RFP and the review of all the corresponding proposals is the Source Selection Evaluation Board (SSEB). It is important to note that the SSEB is constituted for the entire life of equipment acquisition. This means the individuals can become intimately acquainted with the requirements of the individual cases. This comprehensive understanding of the user requirement coupled with specialized knowledge of the individuals on the SSEB create a climate favorable to rational and objective evaluations.

Case	GSA Price	ADPESO Negotiated Price	Dollar Savings	% Discount
A	$3,300,000	$2,600,000	$ 700,000	21%
B	4,743,612	4,327,981	415,631	9%
C	5,861,976	3,752,796	2,190,180	37%

SOURCE: Information provided by Mr. A.E. Feenan, Head, Specification and Proposal Division, Automatic Data Processing Equipment Selection Office.

Figure 12 -- Navy Savings by ADPESO

The contracting officer is a key ADPESO employee. He devotes all his efforts to contracting for ADPE. By specializing in the procurement of ADPE, this individual has developed an in-depth knowledge, understanding, and appreciation for the particular problems associated with acquisition of the equipment. The results are substantial savings for the Navy as shown in the cases presented in Figure 12.

Evaluation of Selection Procedures

In Chapter III the Navy's selection process was divided into five subcategories. Accordingly, the evaluation of the system will be done by examining each of these areas.

Systems Specifications

First, it is significant to point out that prior to the establishment of ADPESO, there was no standard method by which a user could document his data processing requirement. Each level in the user's chain-of-command had its own unique set of requirements concerning what information should be included and the format in which the specifications were to be presented. Accordingly ADPESO's most important initial contribution to computer selection in the Navy was to promulgate instructions that standardized the format of the specifications.[1]

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[1]E. O. Joslin, "Competitive Computer Selection Within the Department of the Navy," (Unpublished paper presented to the Diebold Group, Inc., October, 1969), p. 5.

The specification review conducted by ADPESO is very extensive. This review plus the standardized format provides the Navy with an objective set of requirements for submission to the equipment suppliers.

It is significant to note that it is the Navy's policy to minimize the number of mandatory requirements contained in the specifications.[2] Every item that is classified as mandatory is carefully reviewed. When the justification does not substantiate the claim the item is reclassified as a desirable feature. This is done so that the specifications will not become so stringent as to either discourage vendor participation or to cause an undue number of proposals to be classified as non-responsive.

The Selection Plan

The selection plan consists of the detailed instructions that will be used to evaluate the proposals submitted by the vendors. The significant feature of the Navy's philosophy here is that the plan must be prepared before the RFP is issued.[3] This means that greater objectivity is injected into the evaluation process. If the plan were not prepared until after the initial review of the proposals, there would be danger of personal preference creeping into the plan.

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[2]U. S., Department of the Navy, "Specifications, Selection and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy Instruction 10462.13, Department of the Navy, Washington, D.C. 20390, p. B-11.

[3]Ibid., p. III-5.

Vendor Liaison

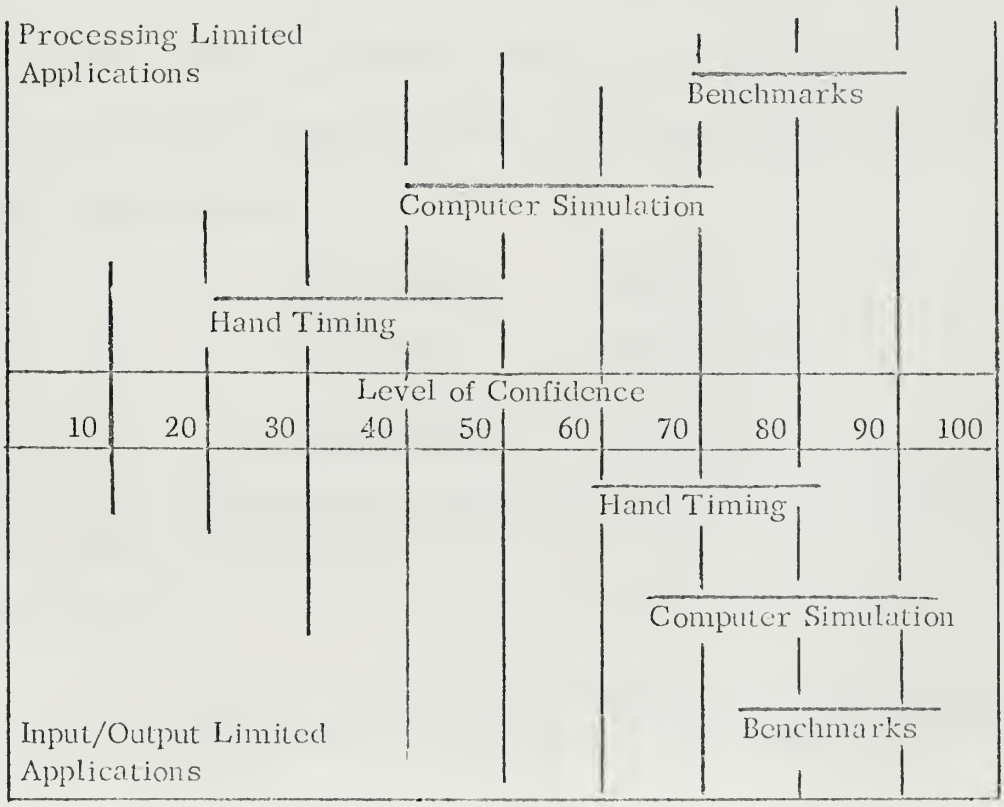
The ADPESO has defined some very meaningful rules that govern the relationship between its representatives and the various manufacturers. The intent of these rules is to establish an impartial and objective way to deal with the vendors. These rules have been provided to the vendors so that they know how to proceed in their dealings with the Navy personnel. One very noteworthy policy is that information provided to one supplier is provided to all and in writing. The comprehensiveness of the policies concerning supplier relations plus the fact that ADPESO is a continuing body staffed with professionals creates a climate for fair and objective interface between the vendors and the Navy.

Validation of Vendor Proposals

The validation of the vendor's proposals is concerned with two areas. First is the verification of the proposed systems capabilities and the second is validation of the system timing. The Navy uses several sources of data to verify the systems capabilities. First, the vendors are requested to provide technical data in their proposal. In addition ADPESO has manufacturer technical manuals and the Auerbach Standard EDP Reports. There is however, a factor that seems to be even more important than these aids--the professional staff at ADPESO. Because these people are continually dealing with the subject matter, their ability to appraise the vendor

claims is certainly greater than what could have been expected prior to the establishment of ADPESO.

The primary method of validating the system timing is through benchmark programs. In Chapter IV two other methods of system timing were discussed—computer simulation and hand timing. There are advantages and disadvantages to each of these methods. In certain instances it is possible that any one would be the best considering all factors. Joslin believes however, that the prime consideration in choosing a timing technique should be the degree of confidence required in the data derived. The following chart indicates the levels of confidence that can be obtained with the three methods. Notice that the confidence levels are shown covering a wide



range. This is necessary to allow for variations in the applications and personnel using the techniques. The information indicates that the highest levels of confidence can be placed in the results obtained from the use of a benchmark program.[4]

There is another significant advantage of using benchmark programs—the programs are run on the system proposed by the vendor. This gives the user an opportunity to determine the effect on the application of such features as: I/o control, central processor administrative and processing functions, effective speed of the various I/o devices, system simultaneity, the software scheduler, and the efficiency of the programming system in using the hardware capabilities.[5]

Another very important item to consider is the cost element. The U.S. Army in 1968, conducted a study designed to determine the advisability of continuing an effort to program a computer simulator. In the course of this review, cost data was developed concerning three timing techniques. The Army found the cost per project for obtaining timing data was:

Hand Timing	$34,124,
Simulation	$78,532, and
Benchmarks	$29,548.[6]

[4]E.O. Joslin, Computer Selection (Reading, Massachusetts: Addison-Wesley Publishing Company, 1968), p. 105.

[5]Ibid., p. 78.

[6]U.S., Department of the Army, Computer System Support and Evaluation Command, Report of the S^3 Study Group System and Software Simulator (Washington, D.C.: December 20, 1968).

Based on this plus other considerations in the study, the Army decided not to continue developing a simulator. Instead, benchmark programs are being used.

There are disadvantages to using the benchmark programs however. Before benchmark programs can be used the actual programs have to be written. This task takes time. The amount of time varies with the complexity of the programs, the knowledge and experience of the programmers, particularly the level of experience with programming languages such as COBOL, FORTRAN, or JOVIAL. This is so because these languages generally can be processed by all the different computers. This time element could cause the user a loss of a state-of-art condition. The influence of this factor should decrease within the Navy in the future for the trend is toward using these higher level languages as a matter of course. In light of the advantages stated perviously, plus the fact that the DOD now requires all services to use benchmarks, it appears that the Navy's use of this technique makes the best of a difficult task.

Evaluation of Vendor Proposals

The method used by the Navy to evaluate vendor proposals is based on the Cost-Value Technique.[7] In Chapter IV, two other evaluation systems were reviewed—Cost-Effectiveness and the Weighted Scoring methods. There is a great deal of

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[7]Joslin, Computer Selection, p. 18.

similarity between the Cost-Value and Cost-Effectiveness systems. One difference is the way the worth of a desirable feature is derived. Another difference, only slight however, is in the way the workload projection is handled.

The Cost-Effectiveness system does not provide for the probability of the workload falling below the projected reference workload line. In the Navy's system, the user indicates a projected rate of growth and then assigns a probability to the levels above and below the trend line. This approach seems to be more realistic.

The significant advantage of the Cost-Value system versus the Weighted Scoring method, particularly to top management, is that the results are expressed in dollars instead of points. By expressing the evaluation of each vendor proposal in dollars, the senior managers can readily understand what is happening in the evaluation process, but; there is no real need for these people to understand complex and technical data concerning each proposal.

Another important characteristic of the Cost-Value technique not found in the Weighted Scoring system is the ability of the user to analyze cost associated with desirable features. The user can look at worth and cost of a desirable feature and make a sound procurement decision. This capability is particularly important in light of the new pricing policies of ADPE manufacturers.

While the Weighted Scoring system appears to be objective, there is a very significant crack in its wall of objectivity. The factors chosen as the evaluation criteria and the assignment of weights to them is subjective not objective. There are

no objective guidelines to assist buyers in matching requirements with factors or the relative importance of each. It is unlikely that any two analysts, given the job of independently establishing appropriate factors and weights to select the best computer for a particular installation, would arrive at similar conclusions. There also is a possibility that the weights could be juggled and thus lead to almost any result. Further, there is a real danger that by the time the analyst has performed all the necessary weighting and scoring, he might lose sight of their shaky subjective foundation and attach undue significance to the results.[8]

In view of the above factors, it is believed that the Cost-Value technique is the best method of evaluating the vendor's proposals.

Suggested Improvement

While the Navy's selection system is excellent, there is one area that could be made even more meaningful. Currently the method of costing the vendor proposal results in a figure that is the most probable. This figure is derived by the method described in Chapter III. Basically the calculations involve a monthly workload cost at various levels plus the probability of operating at these levels and a discount factor.

Mr. David Hertz proposes a way of informing the executive of the uncertainity surrounding capital investment decisions.[9] In this system, probabilities are assigned

[8]John R. Hillegass, "Systematic Technique For Computer Evaluation and Selection," Management Services, VI (July-August, 1969), p. 39.

[9]David B. Hertz, "Risk Analysis in Capital Investment," Harvard Business Review, XXXXII No. 1 (January/February 1964), p. 95.

the various possible outcomes. The cash flows connected with each of these possibilities is calculated. These values are then used to determine the expected net present value. This data is then portrayed graphically. The significant advantage of this is that it allows management to see the expected cash flows plus the variability of the flows and the risk associated with each. The present system contains all of the data required to perform such an analysis. It would be necessary however, to obtain a computer program to perform the required calculations. If this type of analysis were incorporated into the Navy system it is believed that there would be substantial benefits derived. Accordingly it is recommended the Navy conduct a study and investigate the feasibility of using a risk analysis technique in its evaluation process.

Since ADPESO was established, experience with centralized competitive selection of computer systems in the Navy has demonstrated that: the using activities are happier, the vendors are happier because they feel they are being given a true chance to bid, and the cost of selection within the Department of the Navy has been reduced 50 per cent while the number installations has increased 30 per cent. Thus, centralized, competitive computer selection in the Navy has proven to be very satisfactory.[10]

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[10]Joslin, "Competitive Computer Selection Within the Department of the Navy," p. 35.

CHAPTER VI

CONCLUSION

The purpose of this paper has been to appraise the competitive computer selection system used by the U.S. Navy. First, the Navy's system was defined and then alternative methodologies were reviewed in order to have a basis for the appraisal.

The Navy's competitive computer selection system is a highly regulated process. There are many regulations and policies issued by higher authorities such as the Congress, the President, the Secretary of Defense and others.

The Navy does however, have a great deal of latitude in deciding exactly which methodologies will be used to differentiate among vendor proposals.

The Automatic Data Processing Equipment Selection Office is the organization within the Department of the Navy charged with the responsibility for the development and administration of the Department of the Navy plans, policies, procedures, and methods governing ADPE specification preparation, proposal solicitation, proposal evaluation and selection.

The ADPESO is located in the office of the Special Assistant to the Secretary of the Navy, who is designated as the senior ADP policy official in the Navy.

The Navy's competitive computer selection process consists of five major activities:

- Specification Review
- Preparation of the RFP and Selection Plan
- Vendor Liaison and Validation of Proposals
- Proposal Evaluation
- Contract Negotiation and Award

The timing of the proposed computer configurations is validated by using benchmark programs. In conjunction with these programs, a probabilistic workload projection technique is used to define the monthly cost to perform the workload. The monthly costs are consolidated into yearly increments to arrive at the annual costs which in turn are discounted to represent the present value of the total cost to perform the workload over the total system life.

The Cost-Value Technique is used to evaluate the desirable features offered by the vendors. The distinguishing feature of this technique is the assignment of value to desirable features in terms of dollars. Thus, an important benefit derived from the use of this method is improved management understanding of the evaluation process, thereby facilitating meaningful decisions relative to the value of any or all of the desirable features.

By contrast, the Navy could validate the timing of the proposed systems by calculating the times manually or by using a computer simulation routine such as SCERT. These methods however do not provide data that is as reliable as the benchmark programs. In addition, a cost study conducted by the U.S. Army found that

benchmark programs could be prepared and used at a lower cost than the other two techniques.

The Cost-Effectiveness and Weighted Scoring systems are alternative processes that can be used to evaluate vendor proposals. The Cost-Effectiveness and Cost-Value systems are very similar. There is a slight difference in assigning worth to desirable features. There is a marked difference between the Cost-Value and the Weighted Scoring techniques. The most significant is that Cost-Value uses dollars as an evaluation scheme, while the latter awards points based on a predefined point scoring templet. These scores are added up, and the system with the most points ostensibly is the best choice.

The flaw in Weighted Scoring system is that the factors to be evaluated and the weights assigned to them are by necessity, chosen arbitrarily. There are no objective guidelines for matching factors and weights to a particular users needs.

The Author has made one recommendation to improve the Navy system. It has been suggested that a methodology advocated by David Hertz, called Risk Analysis be incorporated in the system.

Public Law 89-306
89th Congress, H. R. 4845
October 30, 1965

An Act

79 STAT. 1127

To provide for the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by Federal departments and agencies.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That title 1 of the Federal Property and Administrative Services Act of 1949 (63 Stat. 377), as amended, is hereby amended by adding a new section to read as follows:

Automatic data processing equipment. Purchase and utilization. 5 USC 630-630g-1.

"AUTOMATIC DATA PROCESSING EQUIPMENT

"SEC. 111. (a) The Administrator is authorized and directed to coordinate and provide for the economic and efficient purchase, lease, and maintenance of automatic data processing equipment by Federal agencies.

"(b) (1) Automatic data processing equipment suitable for efficient and effective use by Federal agencies shall be provided by the Administrator through purchase, lease, transfer of equipment from other Federal agencies, or otherwise, and the Administrator is authorized and directed to provide by contract or otherwise for the maintenance and repair of such equipment. In carrying out his responsibilities under this section the Administrator is authorized to transfer automatic data processing equipment between Federal agencies, to provide for joint utilization of such equipment by two or more Federal agencies, and to establish and operate equipment pools and data processing centers for the use of two or more such agencies when necessary for its most efficient and effective utilization.

"(2) The Administrator may delegate to one or more Federal agencies authority to operate automatic data processing equipment pools and automatic data processing centers, and to lease, purchase, or maintain individual automatic data processing systems or specific units of equipment, including such equipment used in automatic data processing pools and automatic data processing centers, when such action is determined by the Administrator to be necessary for the economy and efficiency of operations, or when such action is essential to national defense or national security. The Administrator may delegate to one or more Federal agencies authority to lease, purchase, or maintain automatic data processing equipment to the extent to which he determines such action to be necessary and desirable to allow for the orderly implementation of a program for the utilization of such equipment.

"(c) There is hereby authorized to be established on the books of the Treasury an automatic data processing fund, which shall be available without fiscal year limitation for expenses, including personal services, other costs, and the procurement by lease, purchase, transfer, or otherwise of equipment, maintenance, and repair of such equipment by contract or otherwise, necessary for the efficient coordination, operation, utilization of such equipment by and for Federal agencies: *Provided*, That a report of equipment inventory, utilization, and acquisitions, together with an account of receipts, disbursements, and transfers to miscellaneous receipts, under this authoriza-

ADP fund, establishment.

Equipment acquisitions and utilization.

85-081 O - 67

Report to Budget Bureau and Congress.

tion shall be made annually in connection with the budget estimates to the Director of the Bureau of the Budget and to the Congress, and the inclusion in appropriation acts of provisions regulating the operation of the automatic data processing fund, or limiting the expenditures therefrom, is hereby authorized.

Appropriation.

"(d) There are authorized to be appropriated to said fund such sums as may be required which, together with the value, as determined by the Administrator, of supplies and equipment from time to time transferred to the Administrator, shall constitute the capital of the fund: *Provided*, That said fund shall be credited with (1) advances and reimbursements from available appropriations and funds of any agency (including the General Services Administration), organization, or contractor utilizing such equipment and services rendered them, at rates determined by the Administrator to approximate the costs thereof met by the fund (including depreciation of equipment, provision for accrued leave, and for amortization of installation costs, but excluding, in the determination of rates prior to the fiscal year 1967, such direct operating expenses as may be directly appropriated for, which expenses may be charged to the fund and covered by advances or reimbursements from such direct appropriations) and (2) refunds or recoveries resulting from operations of the fund, including the net proceeds of disposal of excess or surplus personal property and receipts from carriers and others for loss of or damage to property: *Provided further*, That following the close of each fiscal year any net income, after making provisions for prior year losses, if any, shall be transferred to the Treasury of the United States as miscellaneous receipts.

63 Stat. 384. 40 USC 481, 474.

"(e) The proviso following paragraph (4) in section 201(a) of this Act and the provisions of section 602(d) of this Act shall have no application in the administration of this section. No other provision of this Act or any other Act which is inconsistent with the provisions of this section shall be applicable in the administration of this section.

Scientific and technological advisory services by Secretary of Commerce.

"(f) The Secretary of Commerce is authorized (1) to provide agencies, and the Administrator of General Services in the exercise of the authority delegated in this section, with scientific and technological advisory services relating to automatic data processing and related systems, and (2) to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The Secretary of Commerce is authorized to undertake the necessary research in the sciences and technologies of automatic data processing computer and related systems, as may be required under provisions of this subsection.

"(g) The authority conferred upon the Administrator and the Secretary of Commerce by this section shall be exercised subject to direction by the President and to fiscal and policy control exercised by the Bureau of the Budget. Authority so conferred upon the Administrator shall not be so construed as to impair or interfere with the determination by agencies of their individual automatic data processing equipment requirements, including the development of specifications for and the selection of the types and configurations of equipment needed. The Administrator shall not interfere with, or attempt to control in any way, the use made of automatic data processing equipment or components thereof by any agency. The Administra-

tor shall provide adequate notice to all agencies and other users concerned with respect to each proposed determination specifically affecting them or the automatic data processing equipment or components used by them. In the absence of mutual agreement between the Administrator and the agency or user concerned, such proposed determinations shall be subject to review and decision by the Bureau of the Budget unless the President otherwise directs." Notice to agencies.

Approved October 30, 1965.

Use and Management of Computer Technology

The President's Memorandum to Heads of Departments and Agencies. June 28, 1966

I want the head of every Federal agency to explore and apply all possible means to

—use the electronic computer to do a better job

—manage computer activity at the lowest possible cost.

I want my administration to give priority emphasis to both of these objectives—nothing less will suffice.

The electronic computer is having a greater impact on what the Government does and how it does it than any other product of modern technology.

The computer is making it possible to

—send men and satellites into space

—make significant strides in medical research

—add several billions of dollars to our revenue through improved tax administration

—administer the huge and complex social security and medicare programs

—manage a multi-billion dollar defense logistics system

—speed the issuance of G.I. insurance dividends, at much less cost

—save lives through better search and rescue operations

—harness atomic energy for peaceful uses

—design better but less costly highways and structures.

In short, computers are enabling us to achieve progress and benefits which a decade ago were beyond our grasp.

The technology is available. Its potential for good has been amply demonstrated, but it remains to be tapped in fuller measure.

I am determined that we take advantage of this technology by using it imaginatively to accomplish worthwhile purposes.

I therefore want every agency head to give thorough study to new ways in which the electronic computer might be used to

—provide better service to the public

—improve agency performance

—reduce costs.

But, as we use computers to achieve these benefits, I want these activities managed at the lowest possible cost.

At the present time, the Federal Government

—uses 2,600 computers

—employs 71,000 people in this activity

—spends over $2 billion annually to acquire and operate this equipment, including special military type computers.

Clearly, we must devote our best efforts to managing this large investment wisely and with the least cost.

I approved a blueprint for action when I approved the Bureau of the Budget "Report on Management of ADP in the Government."

The Congress recognized this need when it enacted Public Law 89 306 (the Brooks Bill) last October. This legislation provided specific authorities to

—the General Services Administration, for the procurement, utilization and disposition of automatic data processing equipment

—the Department of Commerce, for the development of data processing standards and the provision of assistance to agencies in designing computer-based systems

—the Bureau of the Budget, for exercising policy and fiscal control over the implementation of these authorities.

These agencies are seeking actively to put into effect ways for improving and reducing the cost of this huge and complex operation.

In my Budget Message for 1967 I told the Congress of my intent to make sure that this huge investment is managed efficiently.

The Federal Government must give priority attention to

—establishing better and more effective procurement methods

—making fuller use of existing facilities through sharing and joint-use arrangements before acquiring additional equipment

—re-utilizing excess equipment whenever feasible

—achieving, with industry cooperation, greater compatibility of equipment.

I expect all agencies to cooperate fully with the Bureau of the Budget, the General Services Administration, and the Department of Commerce in accomplishing these objectives.

I want the Director of the Bureau of the Budget to report to me on December 31, 1966, and every six months thereafter, on the progress that is being made throughout the Federal Government in improving the management of this very important technology.

LYNDON B. JOHNSON

APPENDIX C

THE SECRETARY OF DEFENSE
WASHINGTON

27 JUL 1966

MEMORANDUM FOR The Secretaries of the Military Departments
The Chairman of the Joint Chiefs of Staff
The Director of Defense Research and Engineering
The Assistant Secretaries of Defense
The Assistants to the Secretary of Defense
The Directors of Defense Agencies

SUBJECT: Management and Use of the Electronic Computer

The President's memorandum of June 28, 1966, copy enclosed, directs Heads of Federal agencies to give priority emphasis to exploring and applying all possible means to (1) use the electronic computer to do a better job, and (2) manage computer activity at the lowest possible cost.

It is my desire that the Department of Defense (DoD) not only concentrate its efforts on attainment of the President's objectives but provide an example for the rest of the Government to follow. While tremendous progress has been made during the past five years, I believe we must increase our efforts to achieve more effective use of computers in all facets of Defense management and operations. The President points out that there are 2,600 computers in use in the Federal Government and that 71,000 people are employed to operate them. The DoD operates almost 2,000 of these computers and employs 51,000 of the total personnel. With this large share of the Federal Government investment we must bear a large share of the responsibility for improved management direction in accordance with the President's objectives.

I have reviewed the President's objectives and current DoD policies which are expressed in DoD Directive 5100.40, September 23, 1963, "Responsibilities for the Administration of Automatic Data Processing Equipment Program." I find that this Directive already provides sound policies within which the President's objectives may be achieved.

However, it is essential that we increase our efforts to improve our use of computers. Defense managers must educate themselves on the uses and capabilities of the computer, evaluate and clearly state requirements for management information, and exercise positive

direction to insure that these requirements are met by the computer system. As we intensify the use of computers to perform our tasks more effectively at the least possible cost, the following guidance should be observed:

1. We must take advantage of the tremendous capabilities of the computer for data collection and analysis. We can no longer elaborate computer systems which are merely reflections of earlier manual and punch-card systems, but must build new systems which satisfy our total management and operating requirements and which exploit the unique capabilities of the computer. We must insure a proper man/machine relationship, giving to man and to the machine those duties each performs best.

2. We must develop and install standard data systems within the DoD at a level far exceeding our current practices. These standard data systems must be developed for research and development and operational systems as well as business management-type needs. These systems should be designed to provide for uniform integration within functions on a service/agency-wide basis. Standardization is mandatory for all systems with multi-activity application opportunities. This requires centralized systems design/machine programming at the highest level pertinent to the system application.

3. We must, prior to computer selection, develop and issue system specifications which adequately describe the systems to be performed and which will result in selection of computers which can satisfy the requirements of that specification. We should not be forced to acquire additional units at later dates or replace the computers prematurely because of selections based on inadequate system specifications or on less than responsive vendor proposals. Military Departments and DoD agencies should centrally prescribe and control the development of system specifications for computer acquisition purposes.

4. We must make competitive computer evaluation and selection a professional endeavor and organize and staff for it accordingly. Staffs performing this function for the senior automatic data processing policy officials should be divorced from computer-using organizations. Steps should be taken to assure that these staffs are the sole point of contact with the computer industry on all matters pertaining to computer selection for their respective agencies.

3

5. We must establish [illegible] only after systems have been redesigned to make full use of the improved capabilities of later model hardware, and then only when the gain proves cost effective. In these cases, software design and programming will be accomplished prior to delivery of equipment. Large computers will not be selected until the performance of the complete hardware/software package required by the systems specifications and request for proposal has been clearly demonstrated by either a full-scale or benchmark test. When installation of identical computers is required in multiple installations to operate a standard system, there will be a single prototype installation designated. Delivery of additional computers to other activities should not be made until after full systems and hardware tests at the prototype site have been satisfactorily completed and approval of the senior automatic data processing policy official has been acquired.

6. We must conduct regular reviews and audits of computer system development and programming, and computer operations throughout the DoD in order to control costs and to identify areas for standardization action and additional savings potential. This will include consideration of the use of contractual services for systems design, programming, and machine services in support of DoD missions. Savings should be properly identified in the DoD Cost Reduction Program Reporting System under Departmental Operating Expense Savings.

7. We must obtain the most favorable automatic data processing costs in our cost reimbursement-type contracting.

I have asked the Assistant Secretary of Defense (Installations and Logistics) (ASD (I&L)) to begin immediately a review and evaluation of the overall computer management program in the DoD and to recommend policy changes which he finds are necessary to more fully satisfy the President's objectives. In so doing the ASD (I&L) will:

1. Intensify his conduct of selective management reviews of automatic data processing systems and installations within the DoD. These reviews will give special attention to:

a. Refitting computer systems operations to place more reliance on computer capability;

c. [illegible] system [illegible]
capabilities.

d. [illegible] system design/programming efforts.

e. [illegible] the use of [illegible] services in computer system design/programming.

2. Develop standards for preparing computer system specifications prior to solicitation of proposals from industry.

3. Determine the feasibility of establishing a single computer selection office for commercial-type computers required by the DoD.

4. Determine ways and means for more stringent control of non-competitive selection of computers and recommend changes that may be necessary in DoD Directive 4105.55, September 28, 1963, "Selection and Acquisition of Automatic Data Processing Equipment."

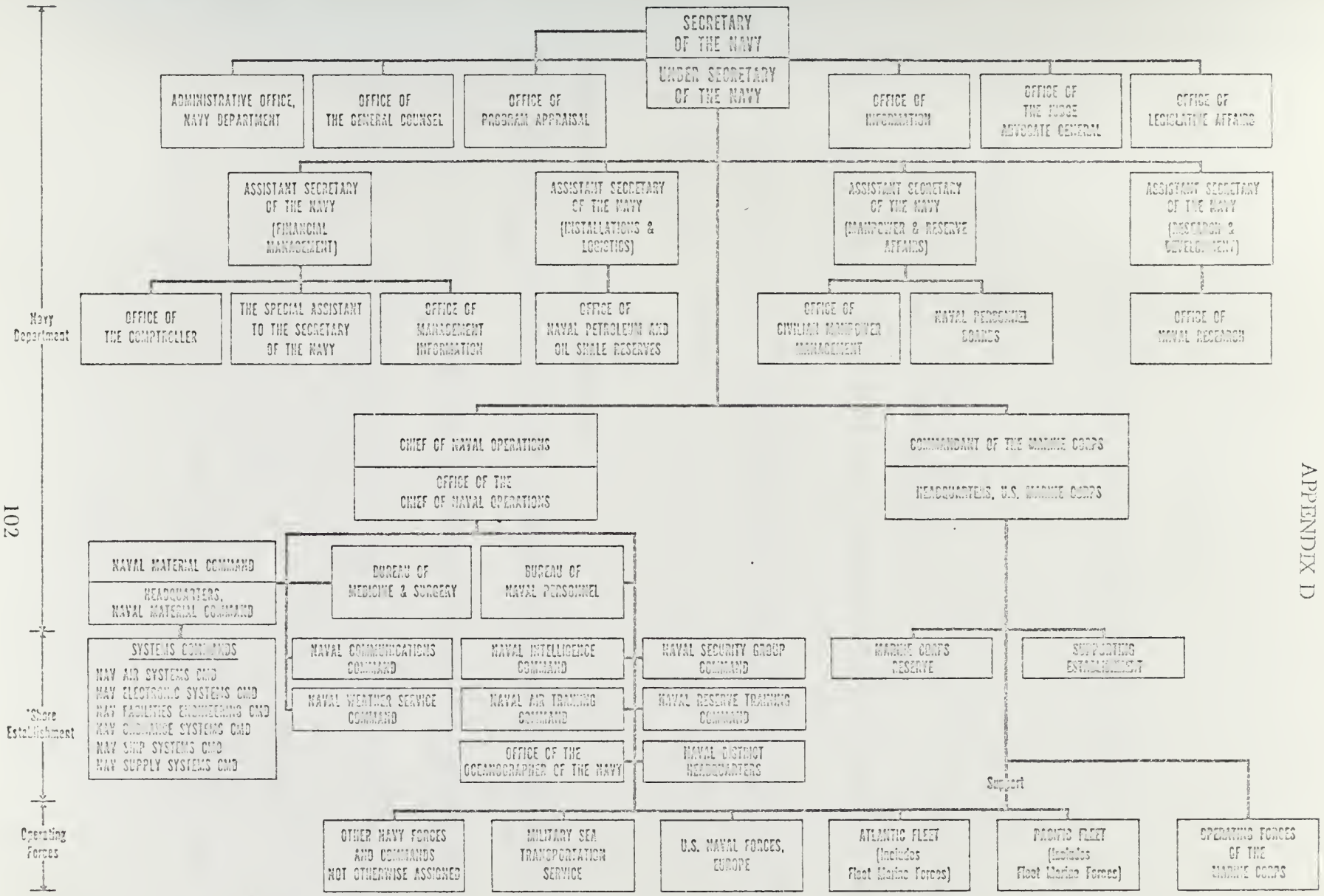
5. Evaluate the DoD computer management information system requirements set forth in DoD Instruction 7700.6, August 10, 1965, "DoD Automatic Data Processing Equipment Program Reporting System," and revise it as necessary to insure availability of adequate information at each management echelon in the DoD.

As the President has indicated, this Department will, of course, cooperate fully with the Bureau of the Budget, the Department of Commerce and the General Services Administration regarding their programs in the computer area. The ASD (I&L) will coordinate these activities for the DoD.

The President has provided the Department of Defense with a great challenge. Each of you should give this matter personal attention and full cooperation.

/s/ ROBERT S. McNAMARA

Enclosure
As Stated



*ALSO INCLUDES OTHER DESIGNATED SHORE ACTIVITIES, NOT SHOWN ON THE CHART, WHICH ARE UNDER THE COMMAND OR SUPERVISION OF MANY OF THE ORGANIZATIONS DEPICTED.

APPENDIX E

DIRECTIVES GOVERNING ACTIONS OF ADPESO

Bureau of Budget Circulars

- A-27, Policies and Responsibilities of the Sharing and Electronic Computer Time and Services in the Executive Branch
- A-54, Policies on Selection and Acquisition of Automatic Data Processing (ADP) Equipment
- A-61, Guidelines for Appraising Agency Practices in the Management of Automatic Data Processing (ADP) Equipment in Federal Agencies
- A-94, Discount Rates and Procedures to Be Used Evaluating Deferred Costs and Benefits

Department of Defense Instructions

- 4160.19, DOD Automatic Data Processing Equipment Reutilization Program, May 8, 1969
- 7041.3, Economic Analysis of Proposed Department of Defense Investments, February 28, 1969
- 5100.40, Responsibilities for the Administration of Automatic Data Processing Equipment Program, September 28, 1963
- 4160.1, Nonexcess Personal Property to be Sold or Exchanged for Replacement Purposes, August 10, 1966
- 4160.21, Department of Defense Personal Property Disposal Program, April 28, 1967

- 4140.34, Department of Defense Personal Property Utilization Program, September 5, 1968

Department of the Navy Instructions

- Comptroller of the Navy Instruction 7000.28, Economic Analysis of Proposed Department of the Navy Investments, April 19, 1967

- Secretary of the Navy Instruction 10462.7B, Department of the Navy Automatic Data Processing Program, March 11, 1966

APPENDIX F

AUTOMATIC DATA PROCESSING SYSTEM SPECIFICATIONS

CONTENTS

SOURCE: U.S., Department of the Navy, Specification, Selection, and Acquisition of Automatic Data Processing Equipment, Secretary of the Navy. Instruction 10462.13, Department of the Navy, Washington, D.C., 20390, p. B-2.

APPENDIX G

COMPUTER SYSTEMS IN SCERT LIBRARY

EMR
6000 Series

Burroughs
100 Series
200 Series
300 Series
2500
3500
5500
6500

Control Data
160A
1604A
1700
3100
3200
3300
3400
3500
3600
3800
6400
6500
6600

General Electric
115
120
205
215
225
235
415
425
435
625
635

Honeywell
110
120
125
200
400
800
1200
1250
1400
1800
2200
3200
4200
8200

IBM
360/20
360/25
360/30
360/40
360/44
360/50
360/65
360/67
360/75
360/85
360/195
1130
1401
1410
1440
1620
7010
7040 Series
705
7070 Series
7080
7090 Series

NCR
315
315 RMC
CENTURY-100
CENTURY-200

ICL
1900 Series
System 4 Series

Digital Equipment
PDP- 6
PDP- 8
PDP- 8i
PDP-10

Philco
2000 Series

RCA
301
501
601
3301
70/15
70/25
70/35
70/45
70/46
70/55
70/60

UNIVAC
III
418
418-III
490 Series
1004 Series
1005
1050
1106
1107
1108
9200
9300
9400

SDS
920
925
930
9300
Sigma 2
Sigma 5
Sigma 7

APPENDIX H

PRODUCTION OF OUTPUT REPORTS

SCERT has been designed to produce a complete series of "standard" output reports but also to be readily adaptable to the production of nonstandard or special purpose reports. The reports of the standard set are all programmed as optional, and the typical use of the program calls for just those reports needed for one's particular analysis. A brief description of the standard reports:

- Computer Complement Report - Portrays the exact configuration that was simulated and provides certain basic cost data about that configuration.

- Central Processor Utilization - Summarizes for each scheduled run the projected running time, set-up time, and horizontal memory utilization.

- Programming Requirements - Projects for each run an implementation-oriented by-product of the simulation by summarizing the number of steps to be programmed and an estimate of the number of programmer man months required.

- Application Summary - If the processing requirements simulated can be broken into discreet application areas, this report summarizes running time and programming effort for each of these areas.

- Computer Capabilities - Tabulates for each scheduled run simulated break-out of thru-put requirements and then a total for the entire simulation. It is used primarily to pinpoint critical hardware areas.

- Cost Summary - Primary cost output which relates the projected utilization of the computer to lease, purchase, and maintenance cost considerations.

- Real-time Analysis - If random real-time processing was involved, a series of reports are produced to portray the impact of such processing on the computer and the response expected of the computer for such processing. The four standard reports are:
  - Event Processing Analysis - Analyzes each random event in terms of its unique thru-put.
  - Hardware Utilization - Analyzes every potential queue present in the hardware complex.
  - Systems Response - Reflects the expected 95th and 99th percentile of computer and communications network response.
  - Memory Requirements - Outlines the unique memory required for each random event and the expected and worst case background requirements.
- Multiprogram Run Schedule - Produced whenever multiprogramming has been simulated and reflects those runs which have been scheduled by the simulator to operate concurrently.
- Detail Analysis - Produced for each scheduled run or real-time event simulated and serves as backup for all other reports. It precisely portrays the utilization, timing, and memory requirements derived by the simulation and presimulation algorithms for all components making up the run.
- Summary Analysis - Summarizes, for each configuration simulated, the performance and cost/performance derived.
- System Documentation - A by-product report which produces a standard form of documentation of all processing requirements. It is especially useful in securing responsive, realistic hardware bids from computer manufacturers.

APPENDIX J

SAMPLE FORMAT FOR DISCOUNTING DEFERRED COSTS AND BENEFITS

Assume a ten-year program which will commit the Government to the stream of expenditures appearing in column (2) of the table below and which will result in a series of benefits appearing in column (3). The discount factor for a 10 percent discount rate is presented in column (4). Present value cost for each of the ten years is calculated by multiplying column (2) by column (4); present value benefit for each of the ten years is calculated by multiplying column (3) by column (4). Present value costs and benefits are presented in columns (5) and (6), respectively.

Year of Operation	Expected Yearly Cost	Expected Yearly Benefit	Discount Factor for 10 Percent	Present Value Cost [Col.(2)x Col.(4)]	Present Value Benefit [Col.(3)x Col.(4)]
(1)	(2)	(3)	(4)	(5)	(6)
1	$10	$ 0	0.909	$ 9.1	$ 0.0
2	20	0	0.826	16.5	0.0
3	30	5	0.751	22.5	3.8
4	30	10	0.683	20.5	6.8
5	20	30	0.621	12.4	18.6
6	10	40	0.564	5.6	22.6
7	5	40	0.513	2.6	20.5
8	5	40	0.467	2.3	18.7
9	5	40	0.424	2.1	17.0
10	5	25	0.386	1.9	9.7
				$95.5	$117.7

The sum of column (5) is present value cost: $95.5.

The sum of column (6) is present value benefit: $117.7.

Present value net benefit is the difference between present value total benefit and present value total cost: $117.7 - $95.5 = $22.2.

The benefit-cost ratio is 117.7/95.5 = 1.23.

NOTE: For more difficult discounting problems, a recommended reference is Principles of Engineering Economy, by Eugene L. Grant and W. G. Ireson, Ronald Press Company, 1960.

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